The Engineer

MAY 16, 1958 — 28 ESSEX ST., STRAND, LONDON, W.C.2 — TWO SHILLINGS

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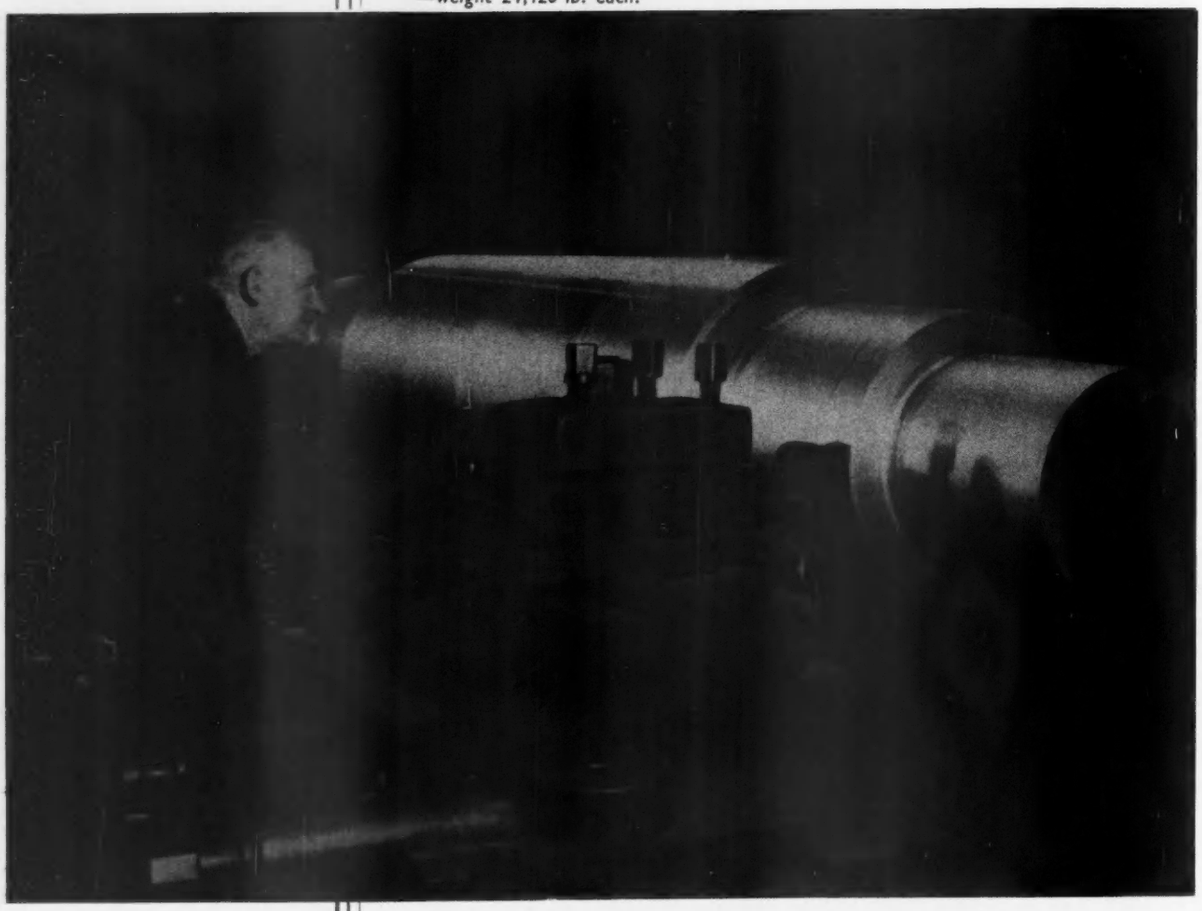

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THE ENGINEER

Established 1856

No. 5338 **MAY 16, 1958** VOL. 205

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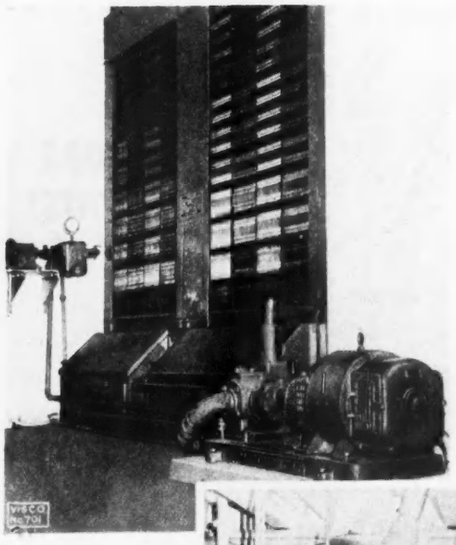
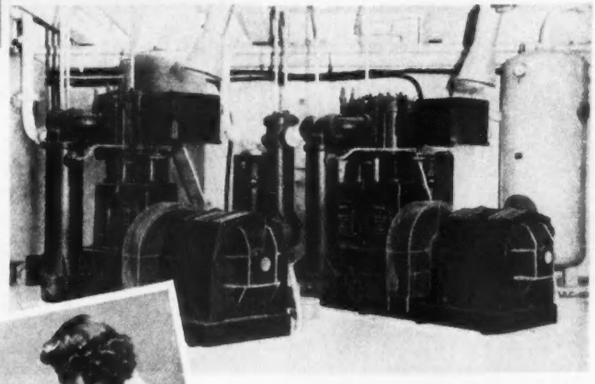
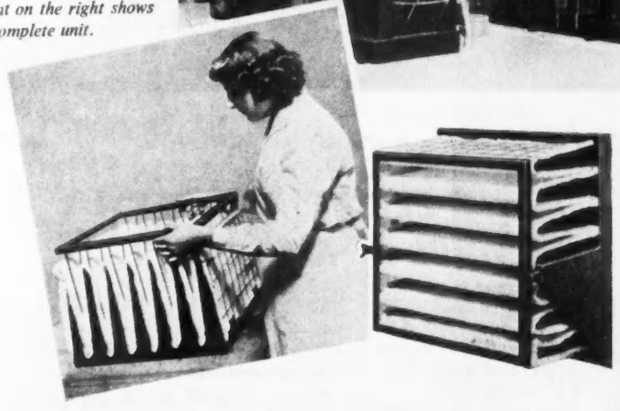


One of five 'Reciprojet' Self-Cleaning Air Filters, total capacity 118,000 c.f.m. at the Albion Works of The Briton Ferry Steel Co. Ltd.

Five "Broomwade" Air Compressors fitted with "Visco" Static Cell type Air Filters, at the Luton factory of Vauxhall Motors Ltd.



"Visco" "M.V." Dry Cell Air Filter. The photo on left shows the ease with which the filter medium can be fitted. That on the right shows a complete unit.



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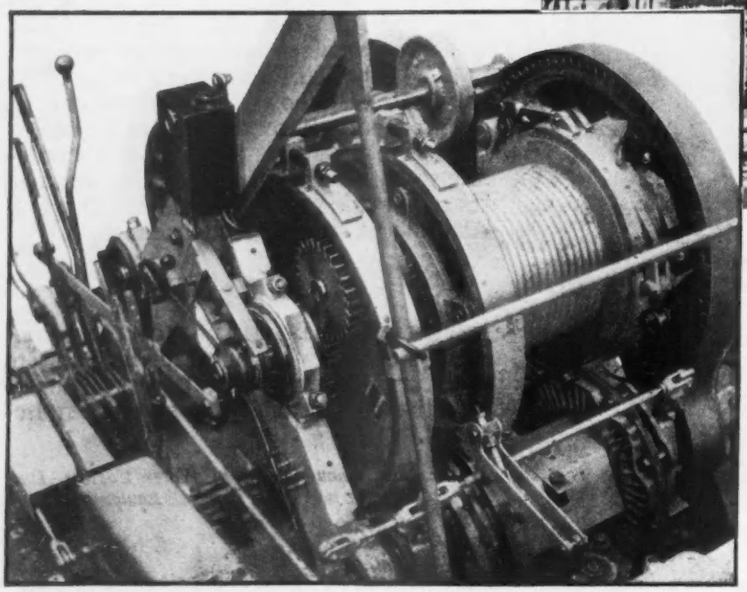

CRANE LOADS UNDER ENGINE CONTROL AT ALL SPEEDS

In this photograph the Smith patent mechanism — a system of planetary gears—can be seen at the left of the rope barrel. The mechanism can be instantly disengaged when necessary.

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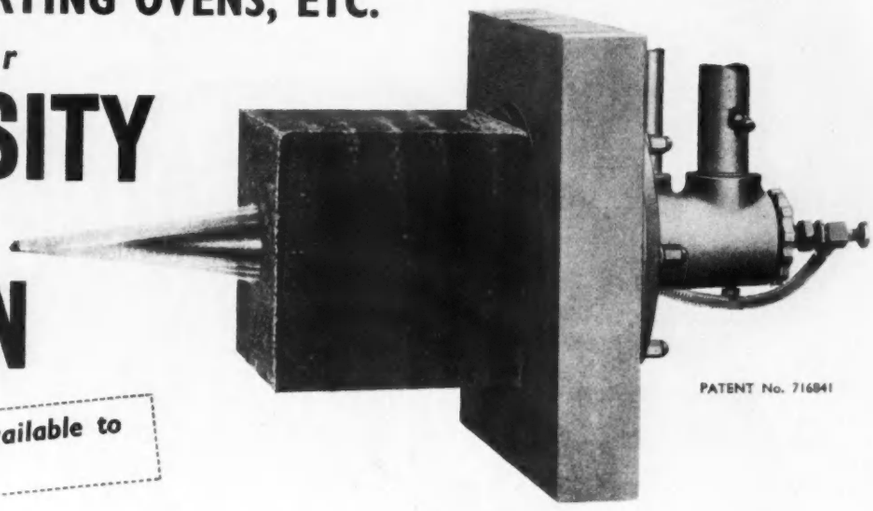

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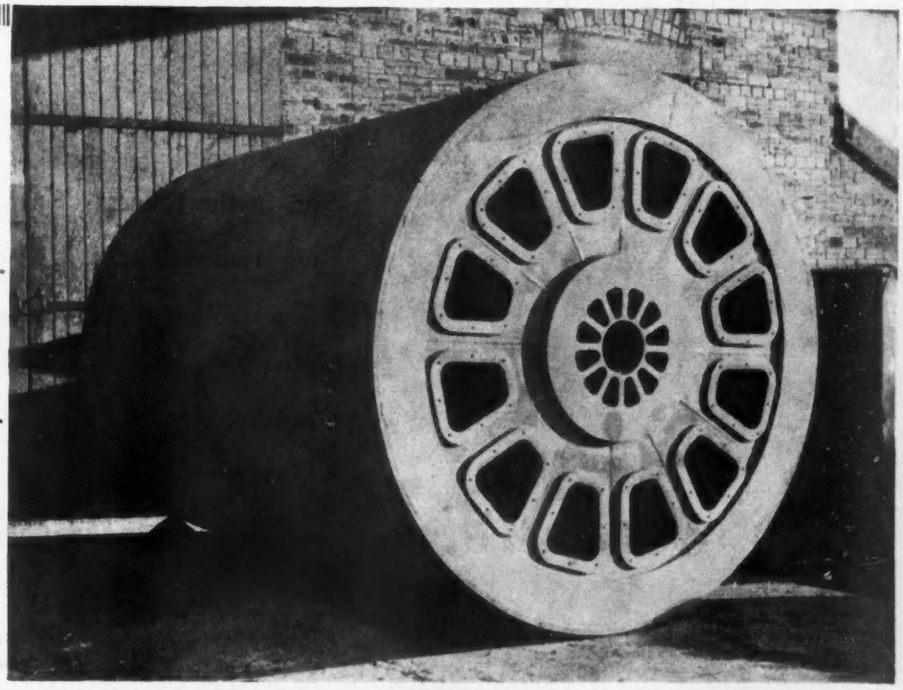

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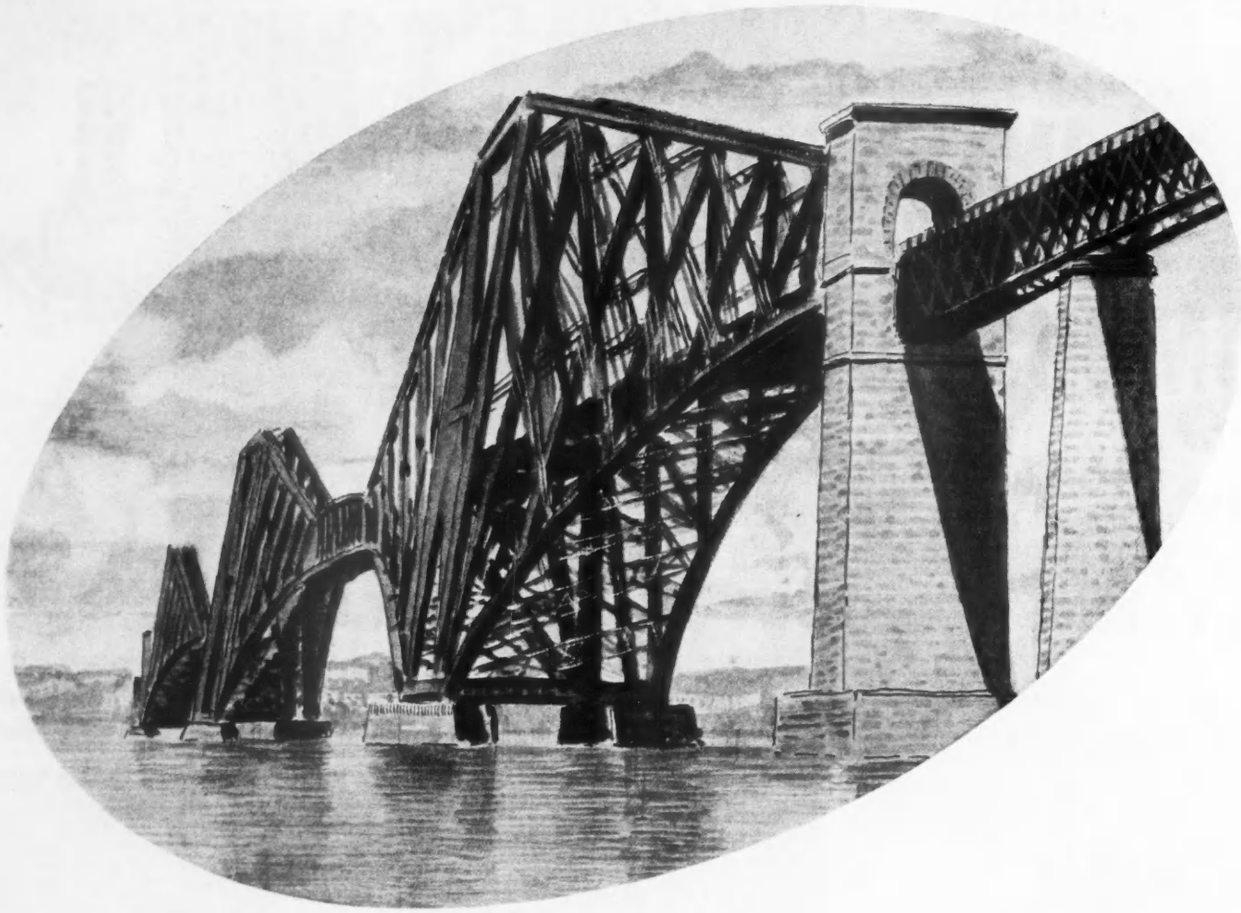

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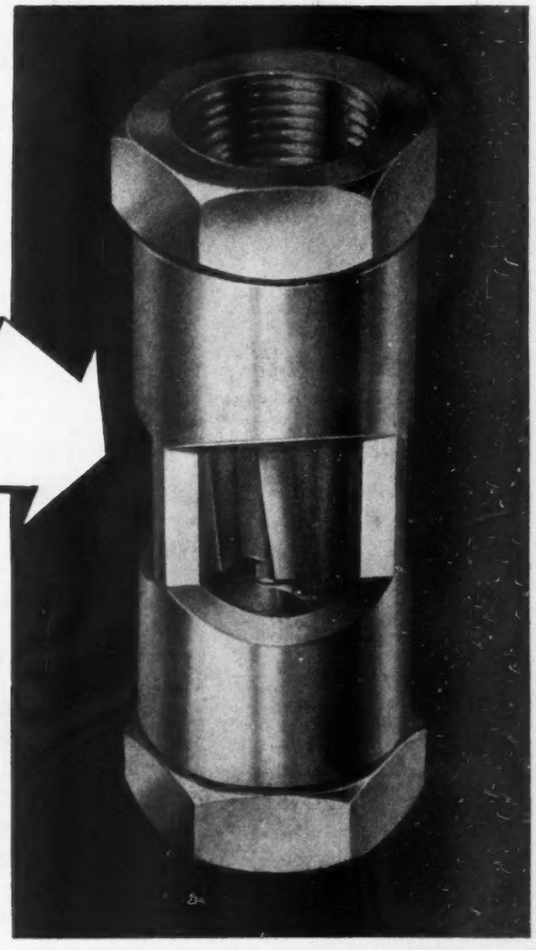

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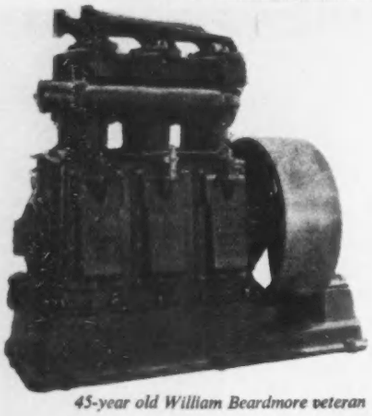
Remember 1913?



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45 years ago, when the first motor 'buses were travelling the streets of London, a "BROOMWADE" stationary Air Compressor was working in the Glasgow works of William Beardmore & Co. Ltd. *It is still working there today!* Installed in 1913, it gave 36 years' trouble-free service before its first overhaul — and even then the cylinders cleaned up at only 0.020 in. oversize. "BROOMWADE" Air Compressors are famed for RELIABILITY.

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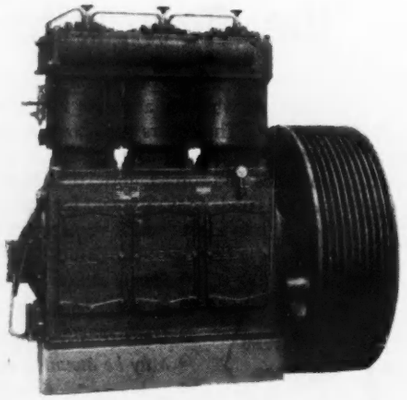

Type EH compressor — a modern development of the design supplied to William Beardmore & Co. Ltd. in 1913

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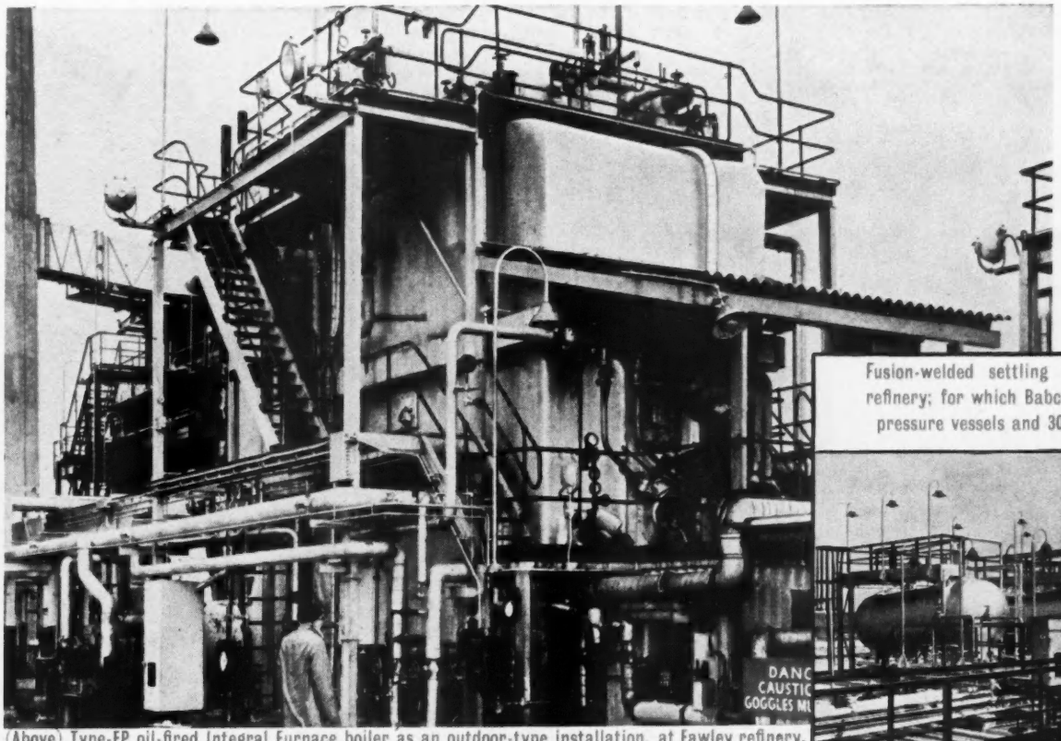

(Above) Type-FP oil-fired Integral Furnace boiler as an outdoor-type installation, at Fawley refinery.

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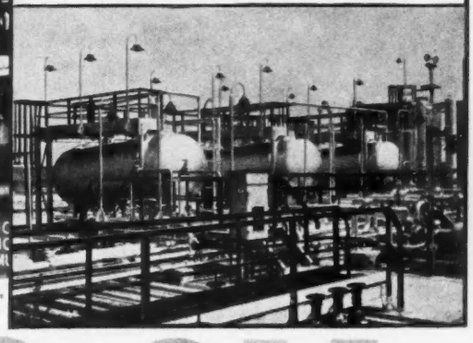
Fusion-welded settling tanks, at Coryton refinery; for which Babcock supplied over 90 pressure vessels and 30 vertical columns.



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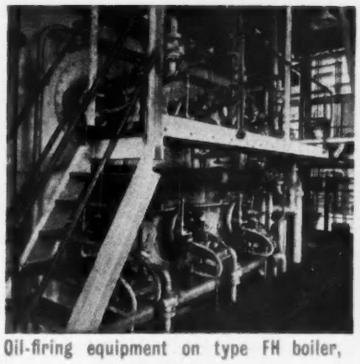
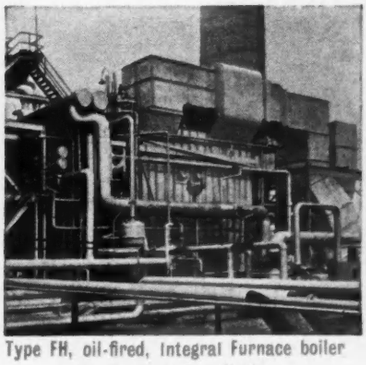


Oil-firing equipment on type FH boiler, Fawley refinery.



Type FH, oil-fired, Integral Furnace boiler as an outdoor installation.

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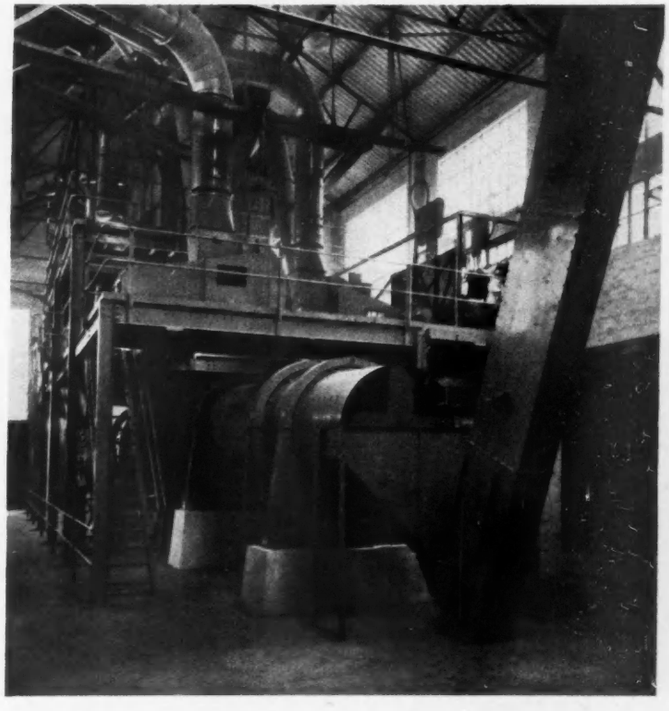

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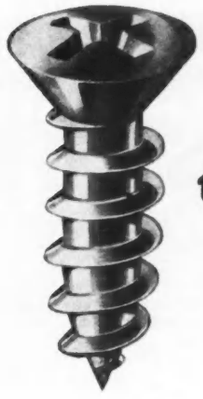

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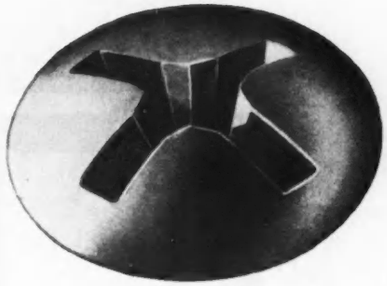

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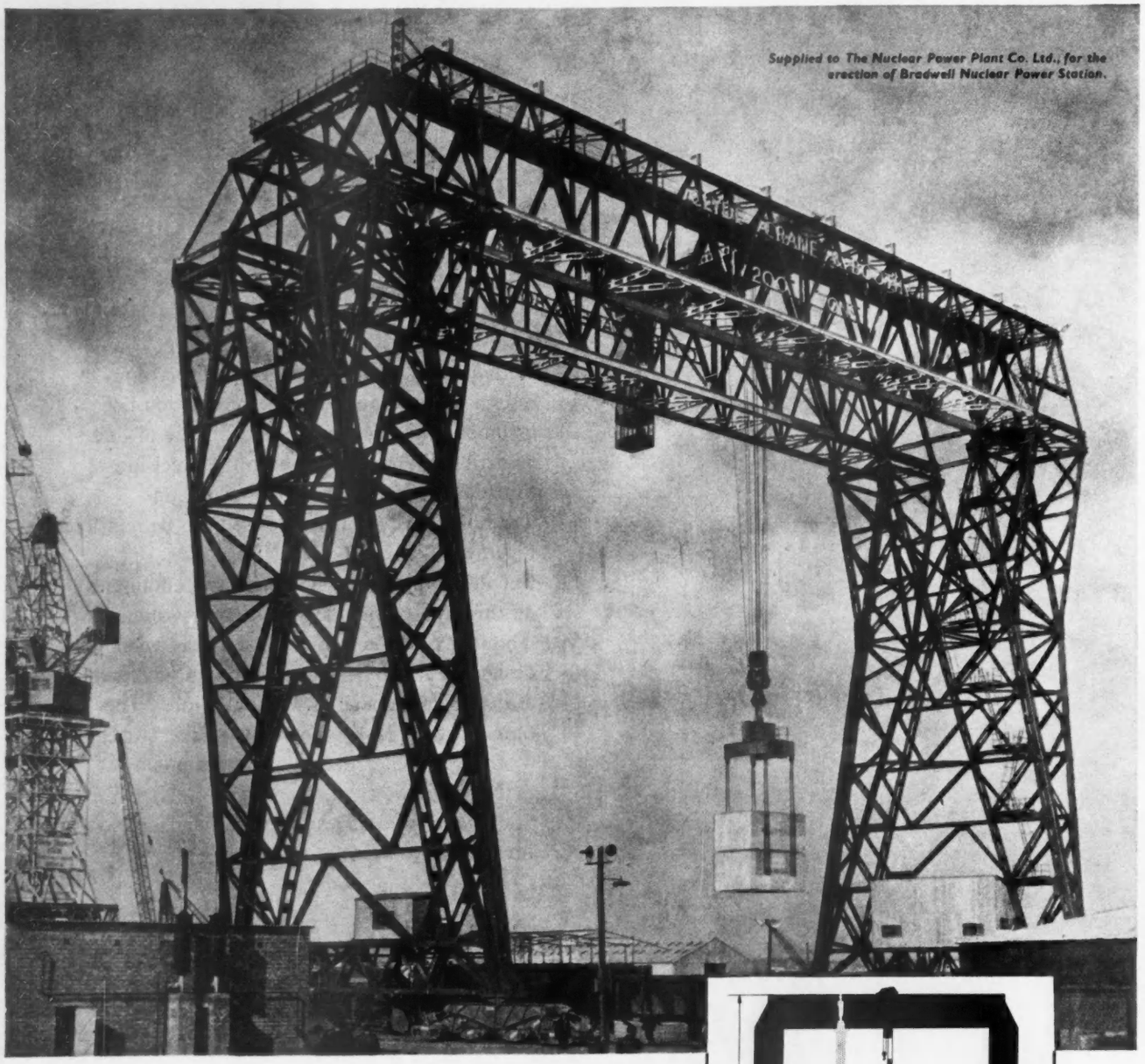
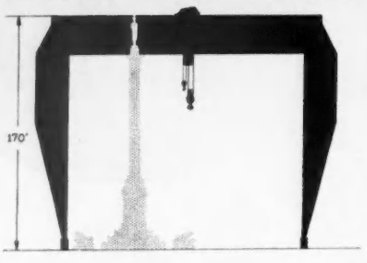


Supplied to The Nuclear Power Plant Co. Ltd., for the erection of Bradwell Nuclear Power Station.

Shown lifting concrete test blocks representing the maximum working load of 200 tons, this Goliath was built by Clyde Crane & Booth Ltd., for the erection of Bradwell Nuclear Power Station. Taking into account the lifting capacity and overall dimensions, it is believed to be the largest of its type in operation in this country and probably the world.



The Booth Goliath showing Nelsons Column on the same scale. Clearance from rail level to underside of bridge is 140'. Distance between rail centres 178'.

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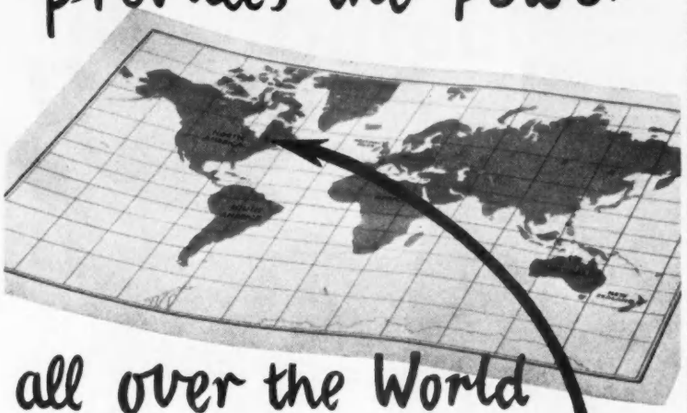

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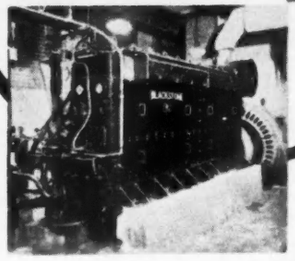

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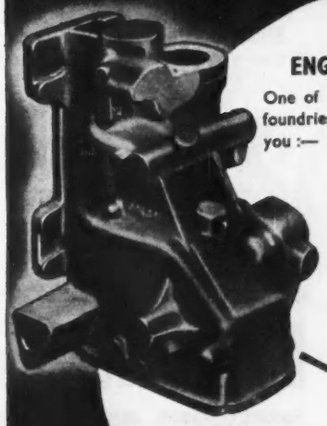

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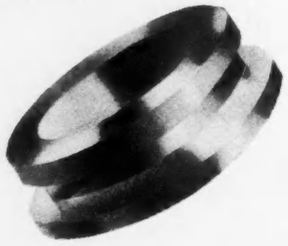

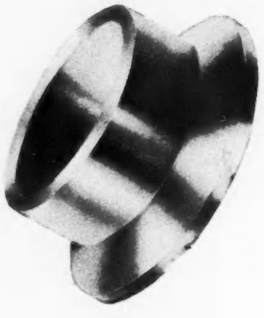

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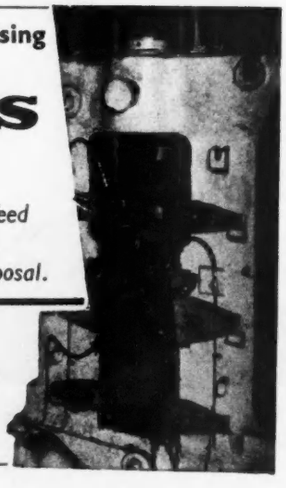

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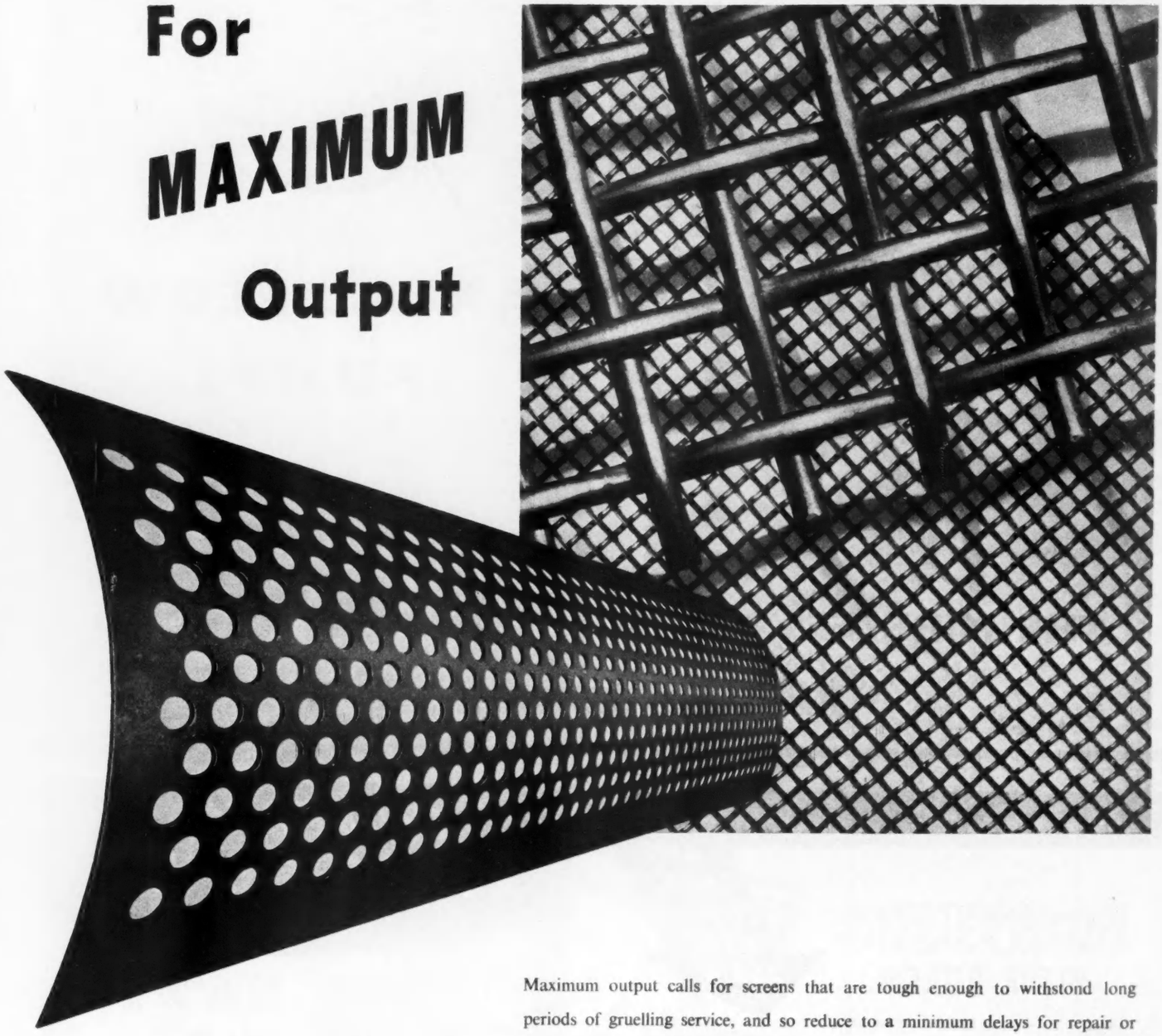

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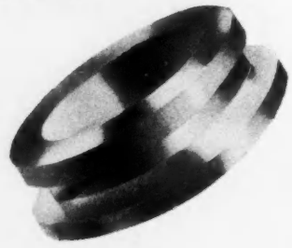

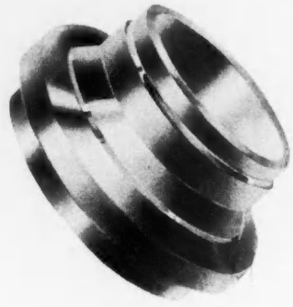

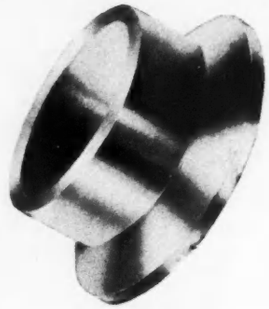

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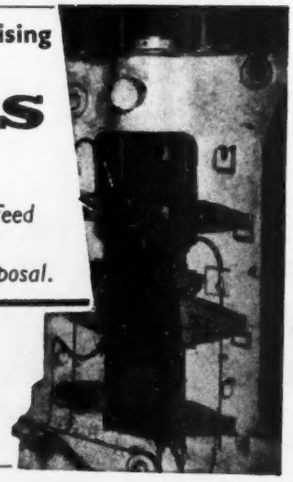

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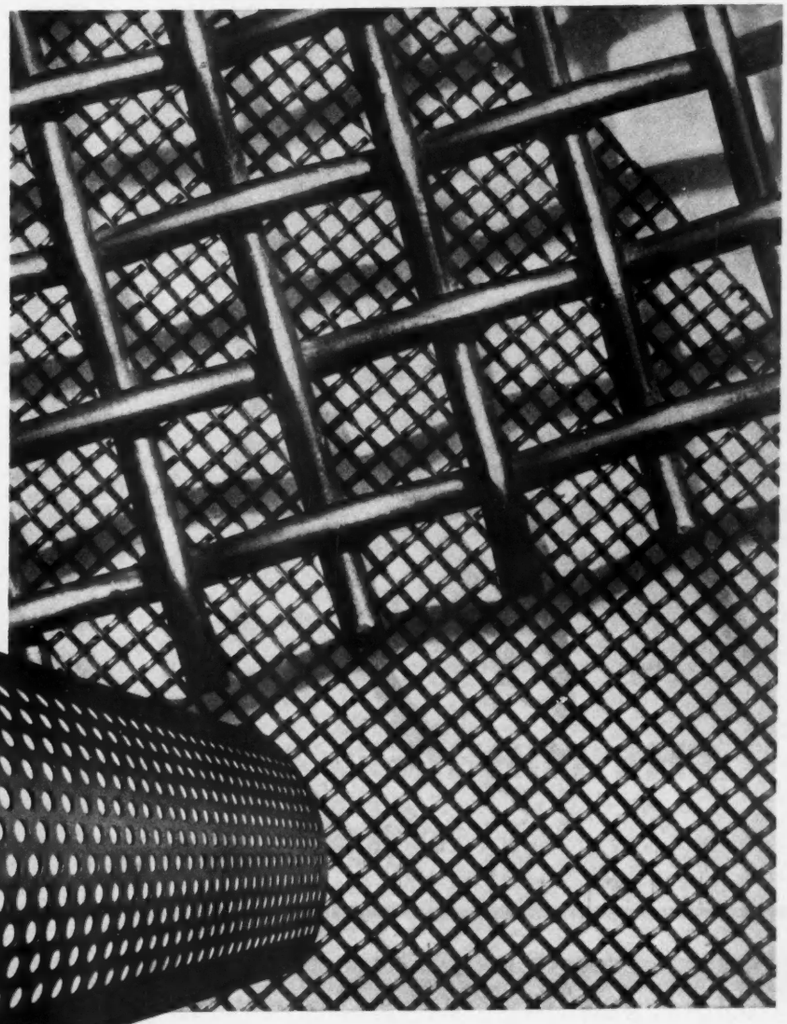

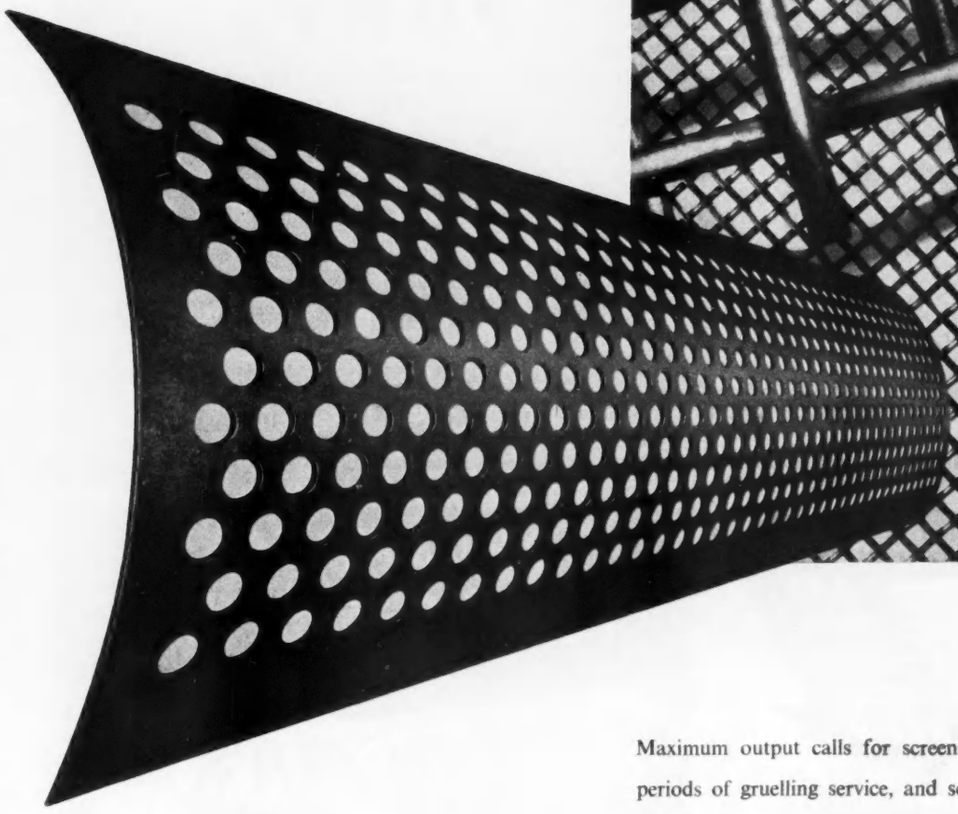

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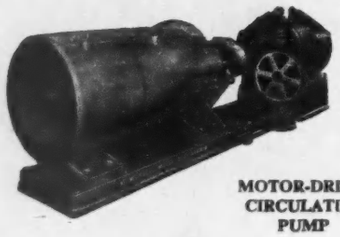

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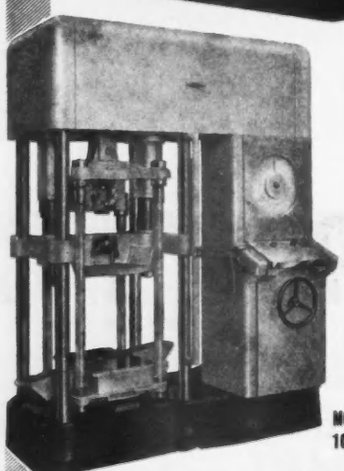

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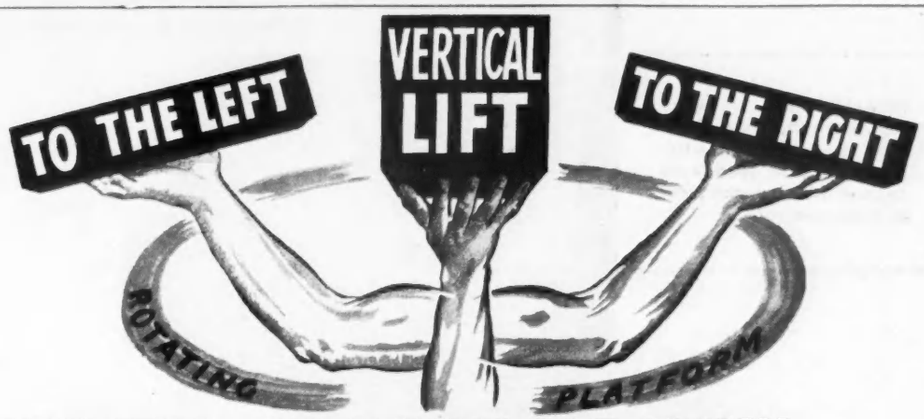

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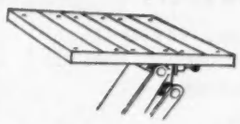

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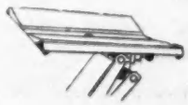

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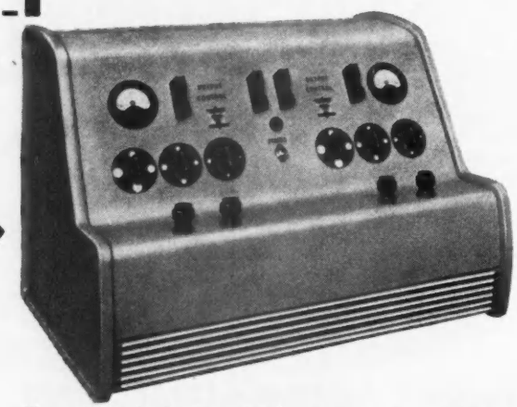

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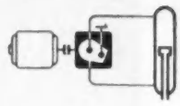

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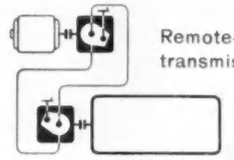

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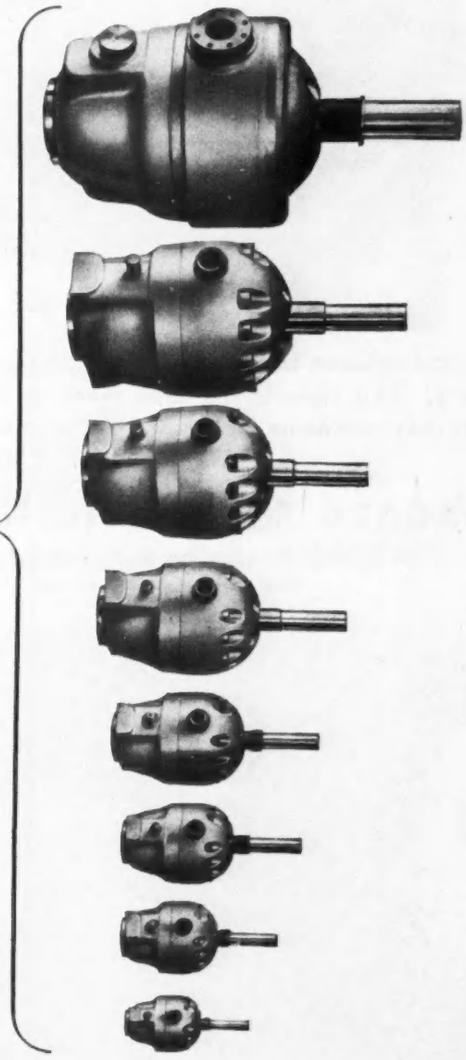

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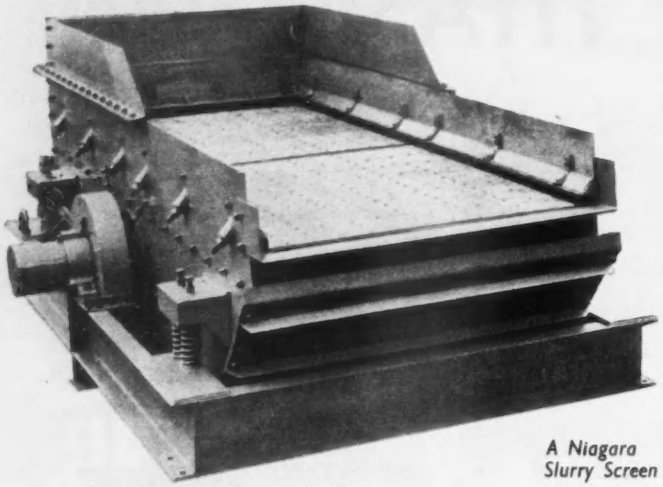

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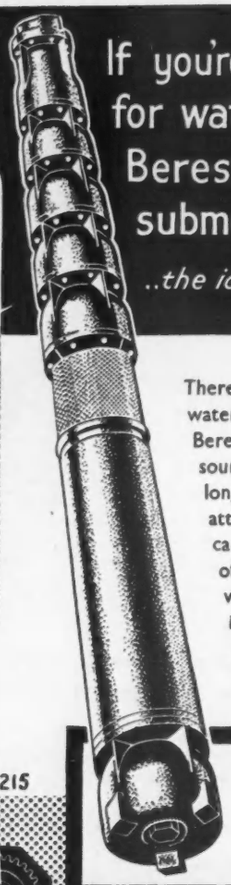

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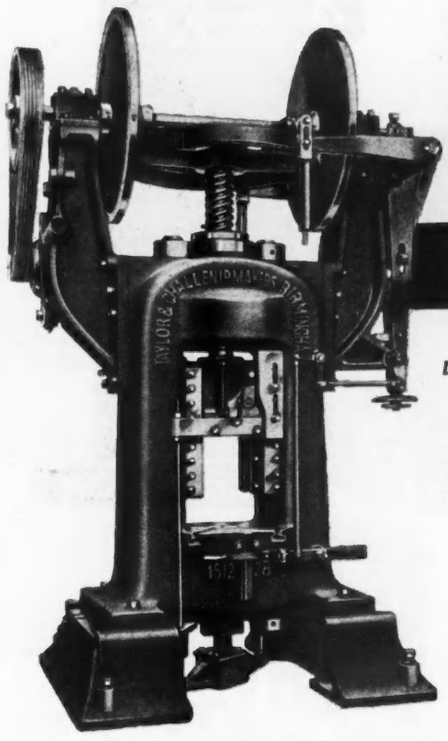
AP 17



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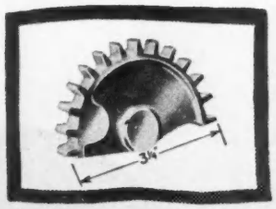

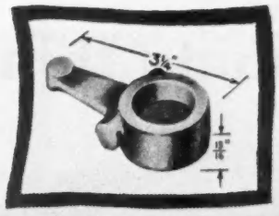

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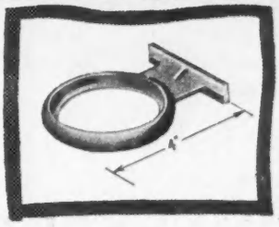

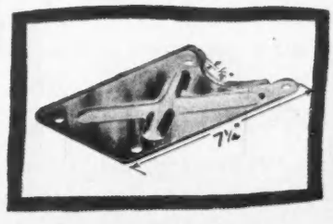

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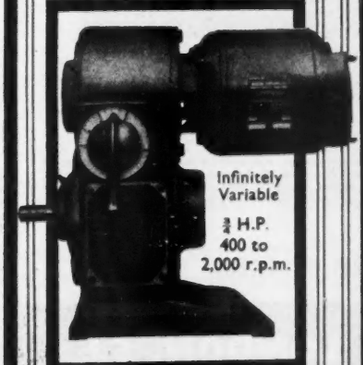

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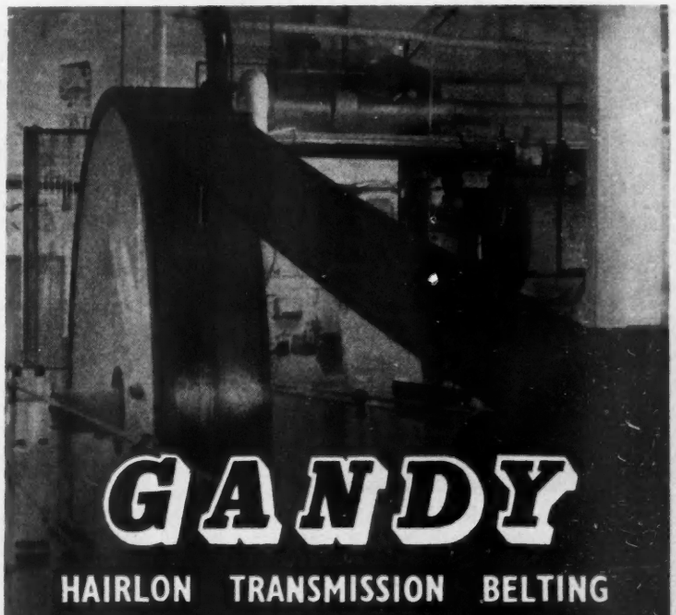

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The meter has a sensitivity of 20,000 ohms per volt on all D.C. ranges, and 1,000 ohms per volt on A.C. ranges from 100V. upwards. Accuracy on D.C. current ranges and A.C. ranges is to B.S. Spec.89/1954 and on D.C. voltage ranges within 2% of indication from full scale to half scale deflection, and 1% of full scale value below half scale deflection.

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"SYKES"

EXTENSIBLE PILE FRAMES

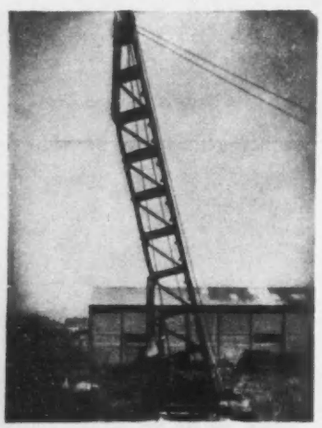

Fig. 202. X.P.H. 75ft.

"Sykes" Pile Frames have always been well known for their strength and reliability; being constructed in accordance with best engineering practice and designed with a full knowledge of the duties which they have to perform, they are able to take the severe punishment meted out to this class of equipment with a minimum of trouble. Within recent years the need to provide pile drivers of greater adaptability has been fully realized and a range of extensible pile frames has been designed and are being made in considerable numbers.

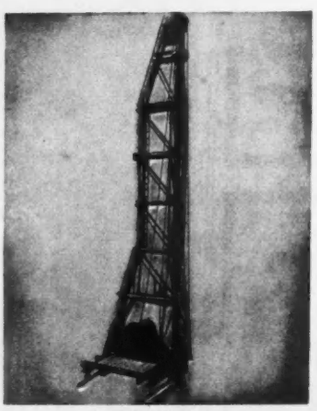

Fig. 210. X.P.L. 51ft.

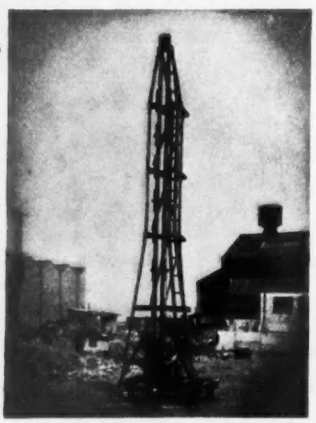

Fig. 205. X.P.S. 32ft.

There are four sizes ranging from 20 feet to 90 feet. These Pile Frames can be erected at the following heights without alteration by means of inserting the required number of box sections. X.P.S.—20 ft., 26 ft. and 32ft. X.P.L.—30 ft., 37ft., 44 ft. and 51 ft. X.P.H.—45 ft., 52½ ft., 60 ft., 67½ ft. and 75 ft. X.P.G.—60 ft., 67½ ft., 75 ft., 82½ ft. and 90ft. Drop Hammers, 1, 2, 3 and 4 Tons, respectively. Raking Piles with maximum batter of 1 in 4 (except X.P.S.) can be driven. Single, double and double equal barrel, steam, electric and diesel driven hoists and winches for monkeys up to 4 tons and piles weighing up to 12 tons with direct lift.

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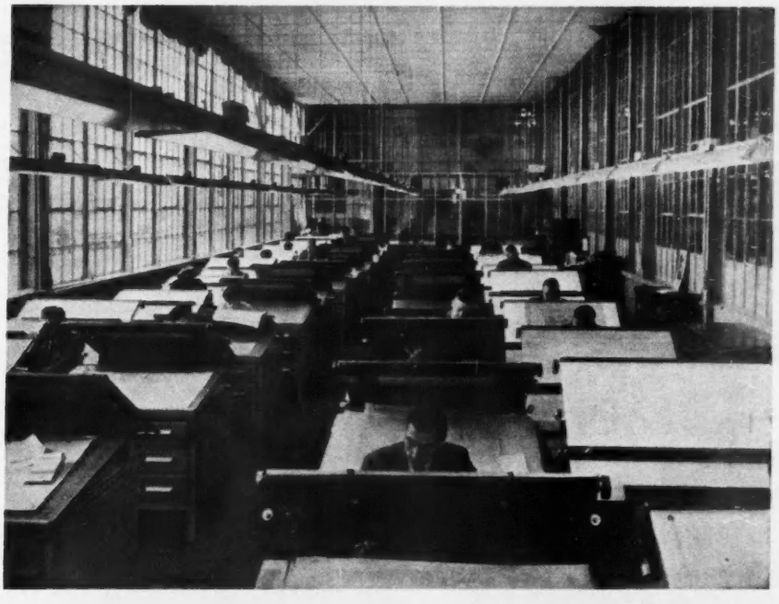

The top illustration is published by courtesy of Messrs. Laurence Scott & Electromotors Ltd., of Norwich. The equipment consists of Arclight Combined Drafting Reference Units fitted with Mason Minor Drafting Stands.

The centre illustration is published by courtesy of Messrs. Crane Ltd., of Nacton Works, Ipswich. Installed in this drawing office, also, are Arclight Combined Drafting Reference Tables fitted with Mason Minor Drafting Stands.

The lower illustration is published by courtesy of Messrs. Albion Motors Ltd., Scotstoun Works, Glasgow, and is a view of their Tool Drawing Office. The equipment installed here consists of Arclight Practical Drafting Stand Assemblies.

E. N. Mason & Sons Ltd., manufacture ranges of all types of drawing office equipment and furniture for all sizes of drawing offices. If you are contemplating any equipment scheme please consult the specialists — consult :-

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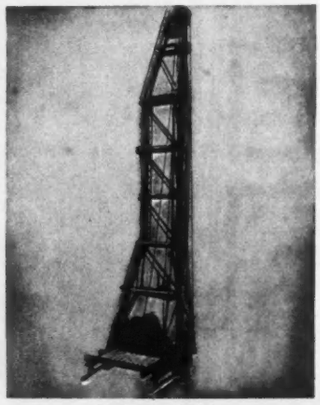

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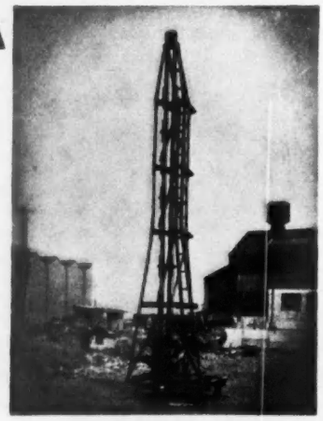

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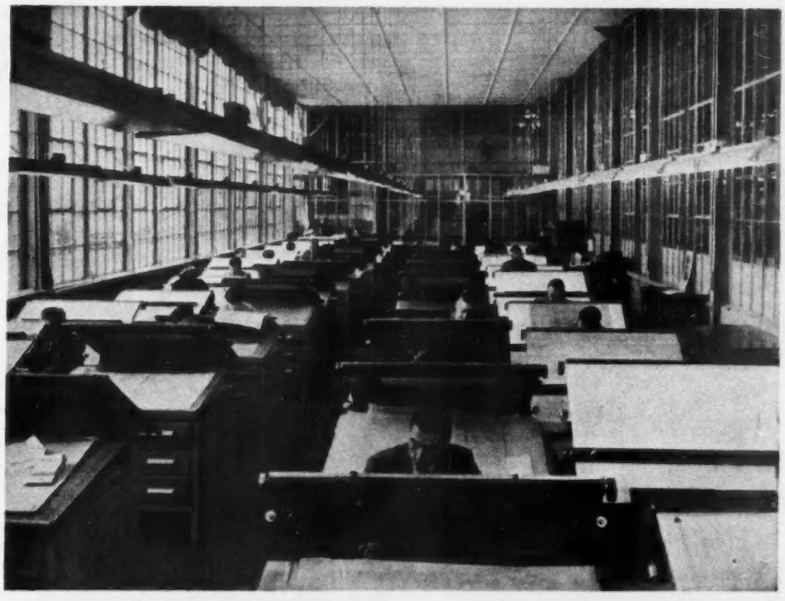

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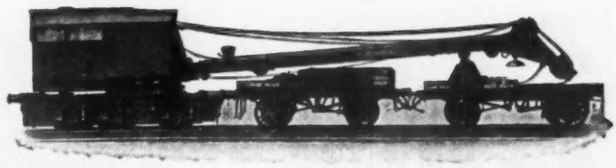
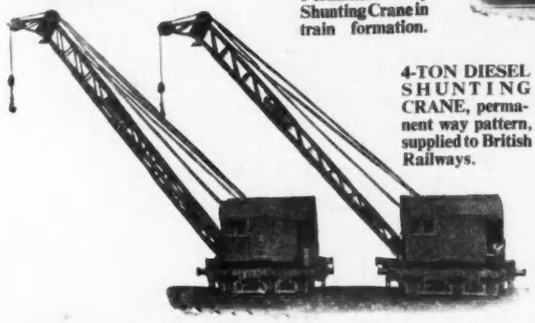


10-ton Diesel Permanent Way Shunting Crane in train formation.



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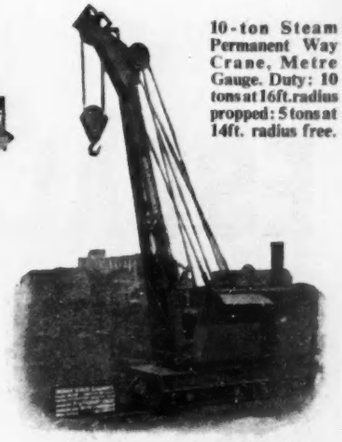

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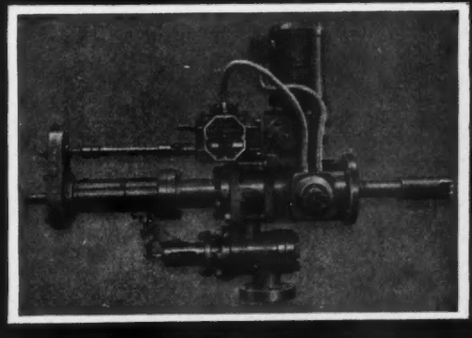

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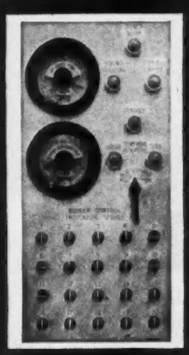

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Simple controls to operate the automatic sequence are grouped on this small unit which takes up little space on the main boiler control panel.

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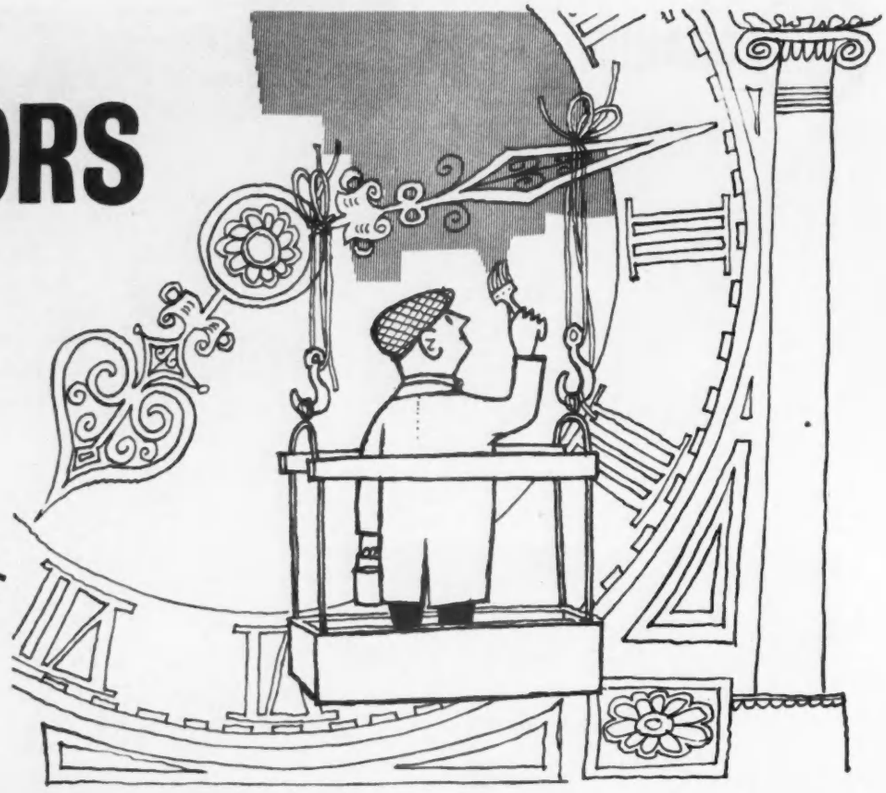

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AP93

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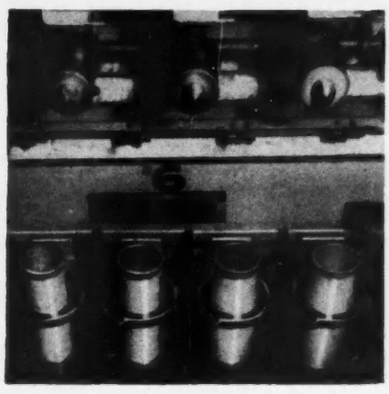

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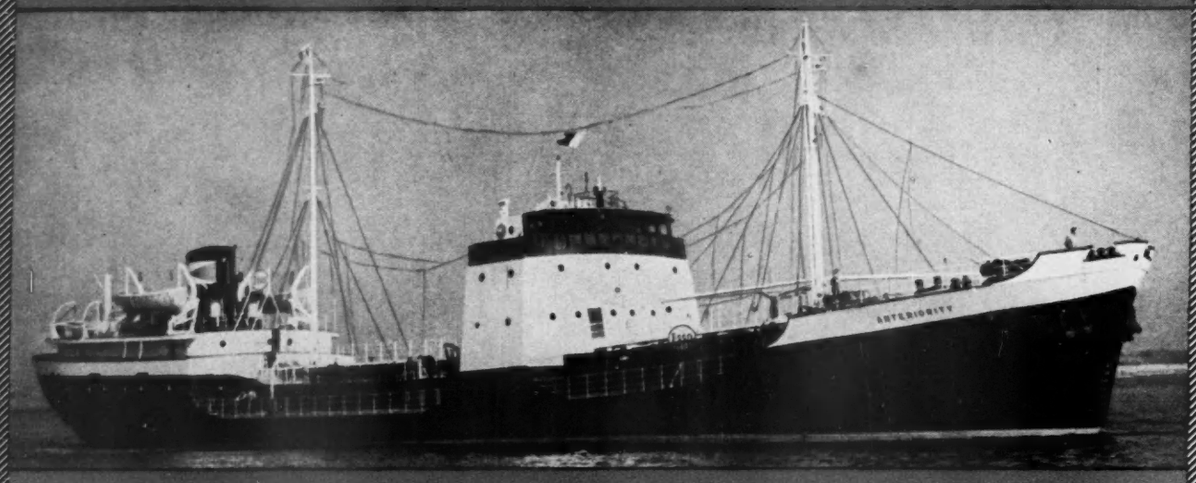
PLATES



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AF. 162

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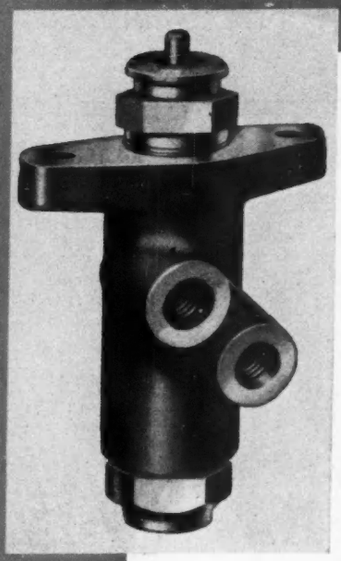
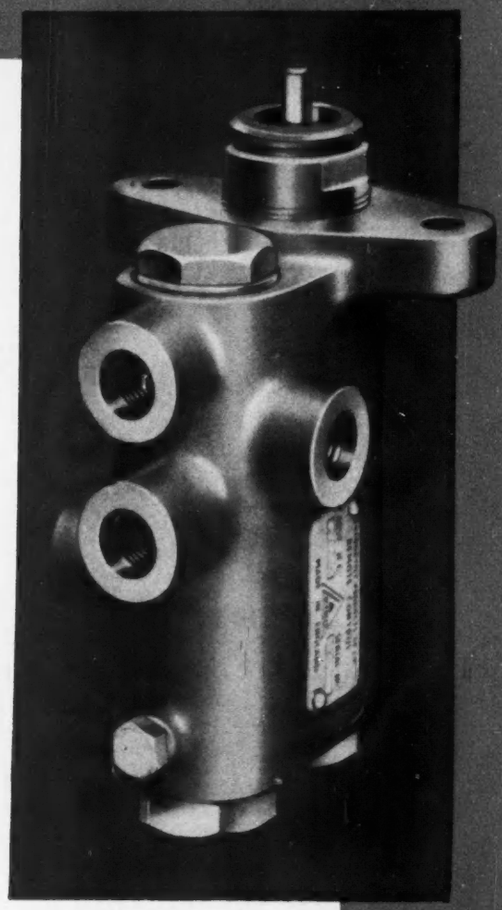


MICRO-VALVES



Lockheed micro-valves are adaptable to a great variety of applications.

The micro-valve shown at left, is primarily intended for use as a pilot valve controlling a hydraulically-operated main control valve. It can, however, be employed as the main control valve itself when the flow of operational fluid is less than ½ g.p.m.

PILOT-OPERATED VALVE *(four-way)*

On the right is shown an integral unit comprising a micro-valve acting as pilot to a small control valve. Suitable for main operational flows up to 6 g.p.m. For greater flows, the mirco-valve is used in conjunction with Lockheed main control valves of the ½" B.S.P. type.

OPERATION. Both the micro-valves and the pilot-operated valves may be operated by electrical or pneumatic thrustors, or by mechanical means, provided that their plungers are not subjected to side-thrust.

By-pass valves, generally similar to the micro-valves, are available in two types; one normally closed and the other normally open.

For further details please write for leaflet No. RC/607/2 and kindly mention this journal.

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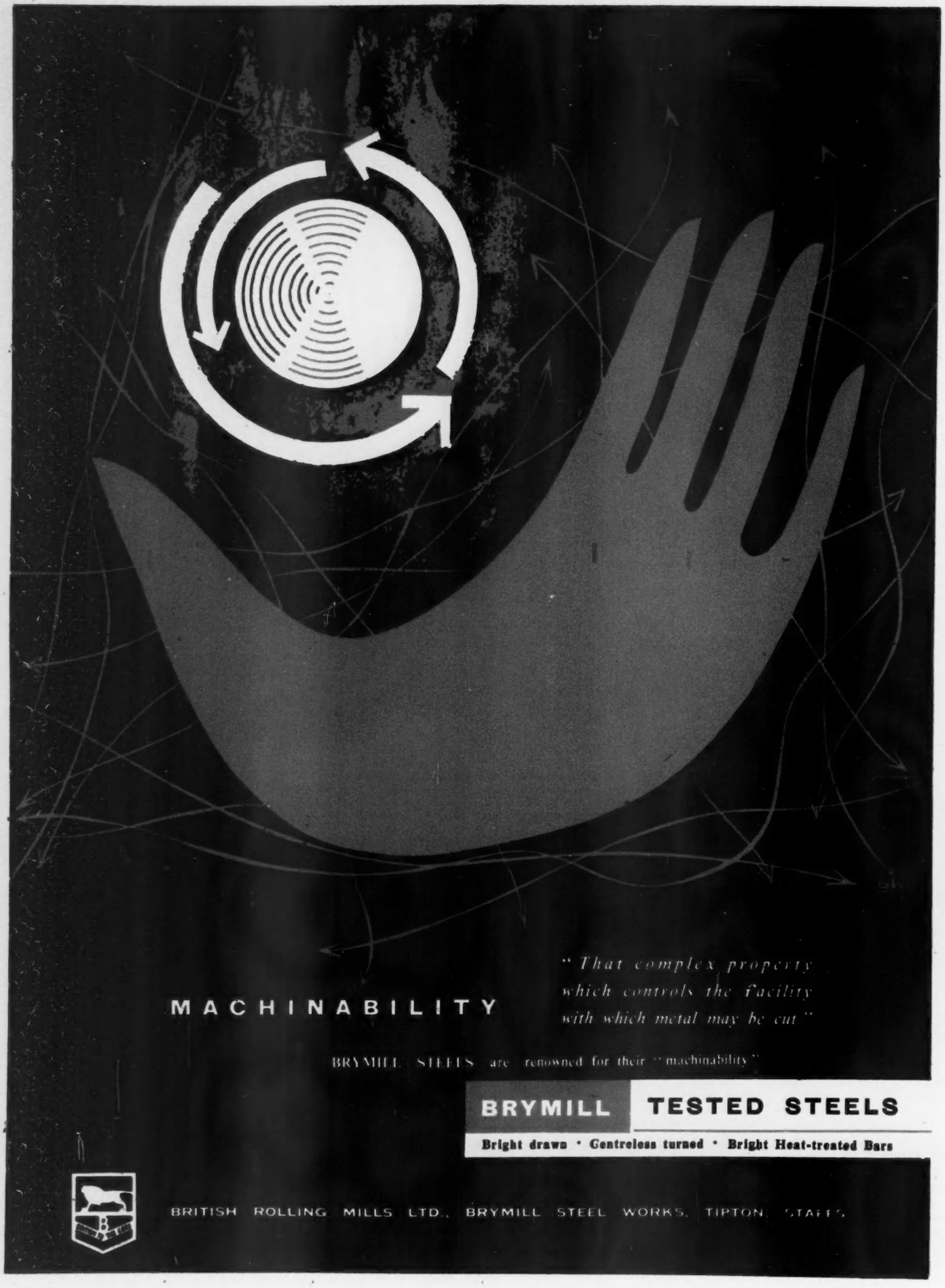
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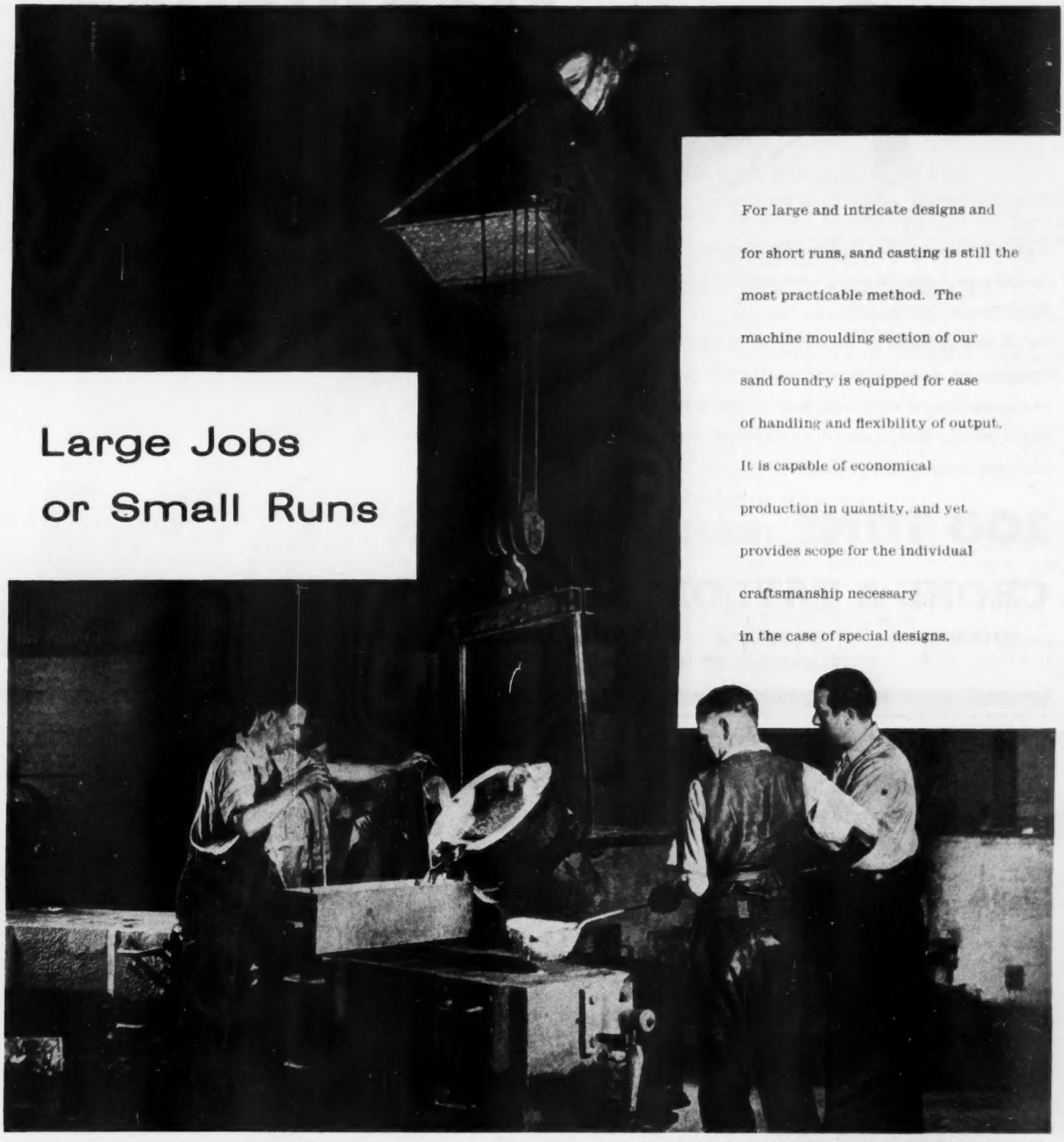

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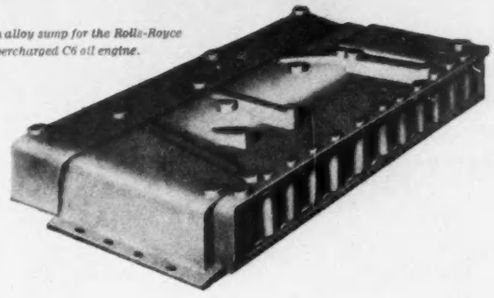

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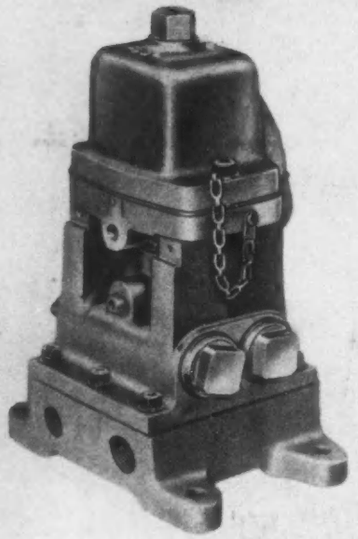

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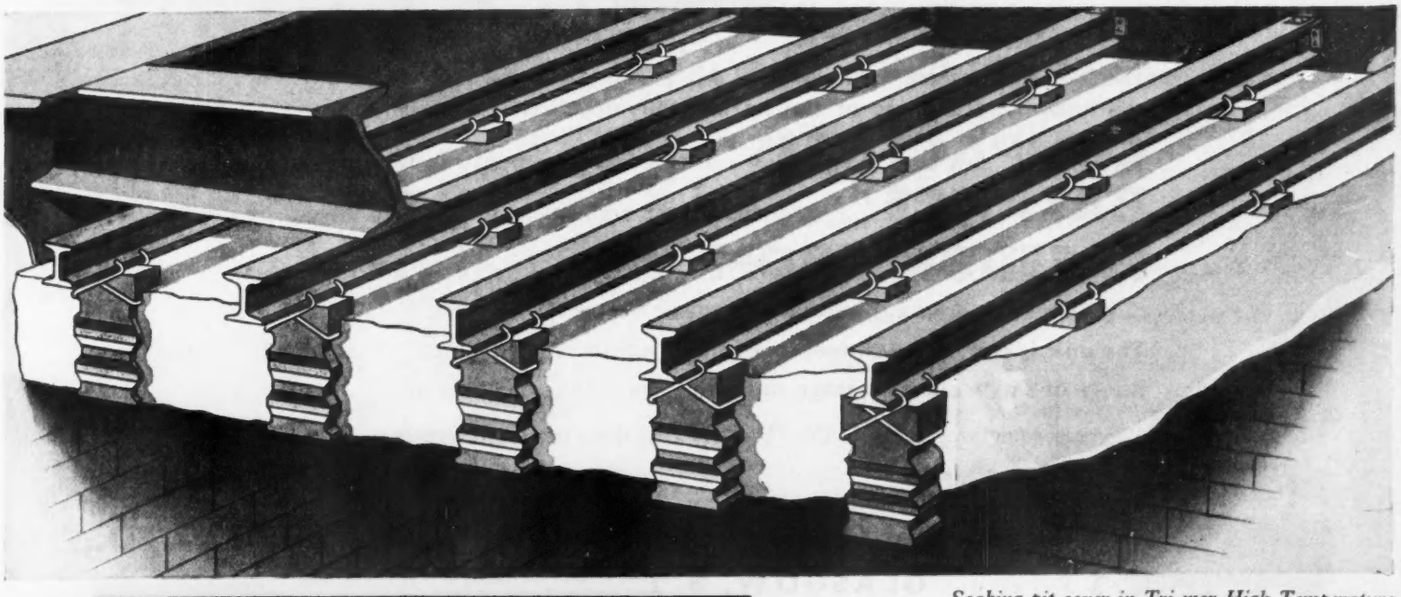

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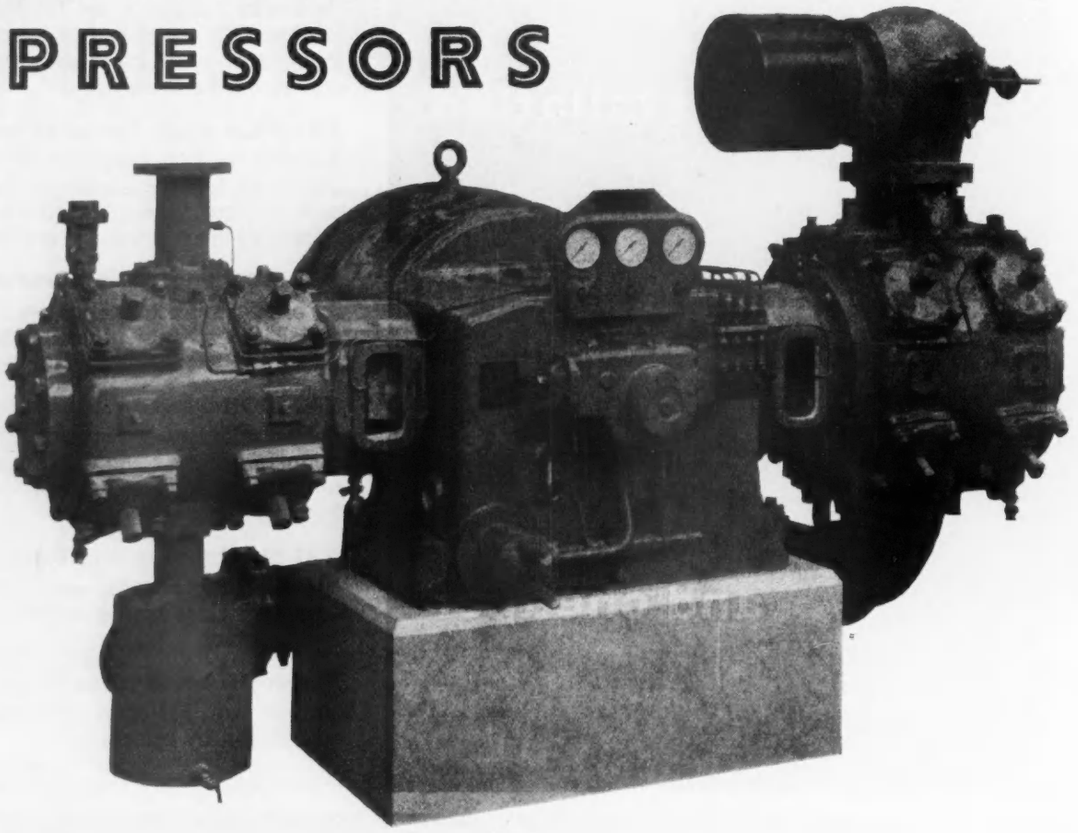

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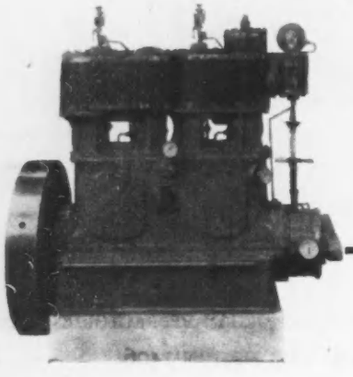

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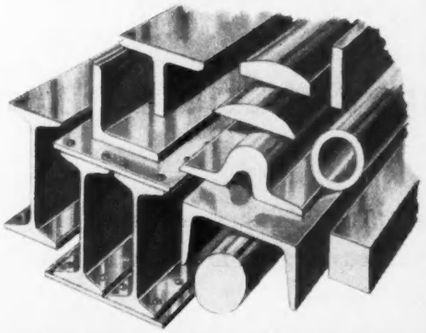

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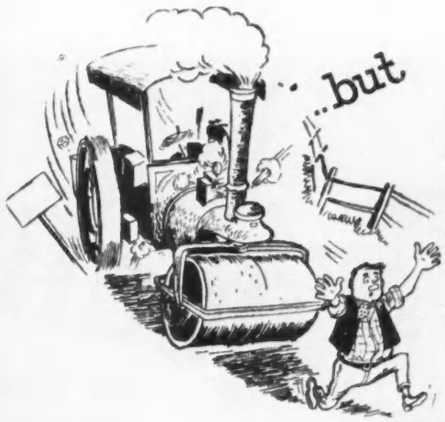

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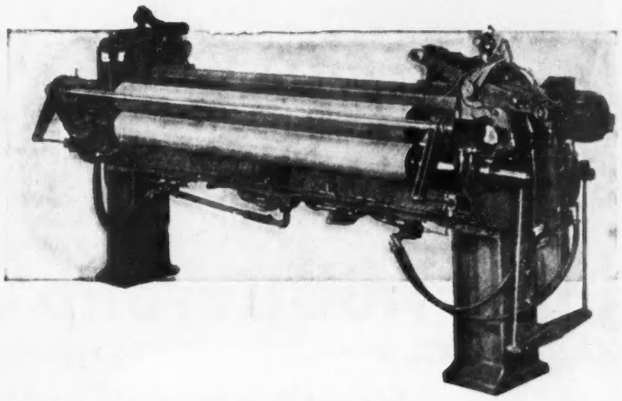

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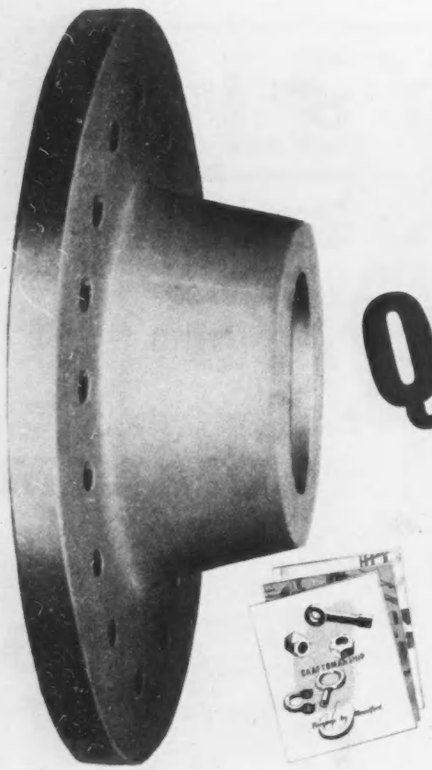

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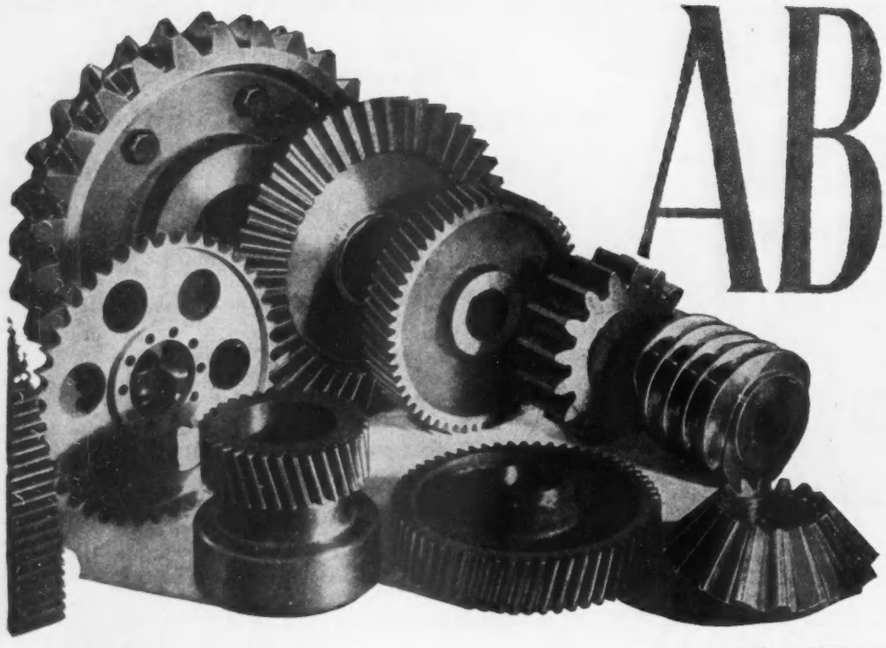

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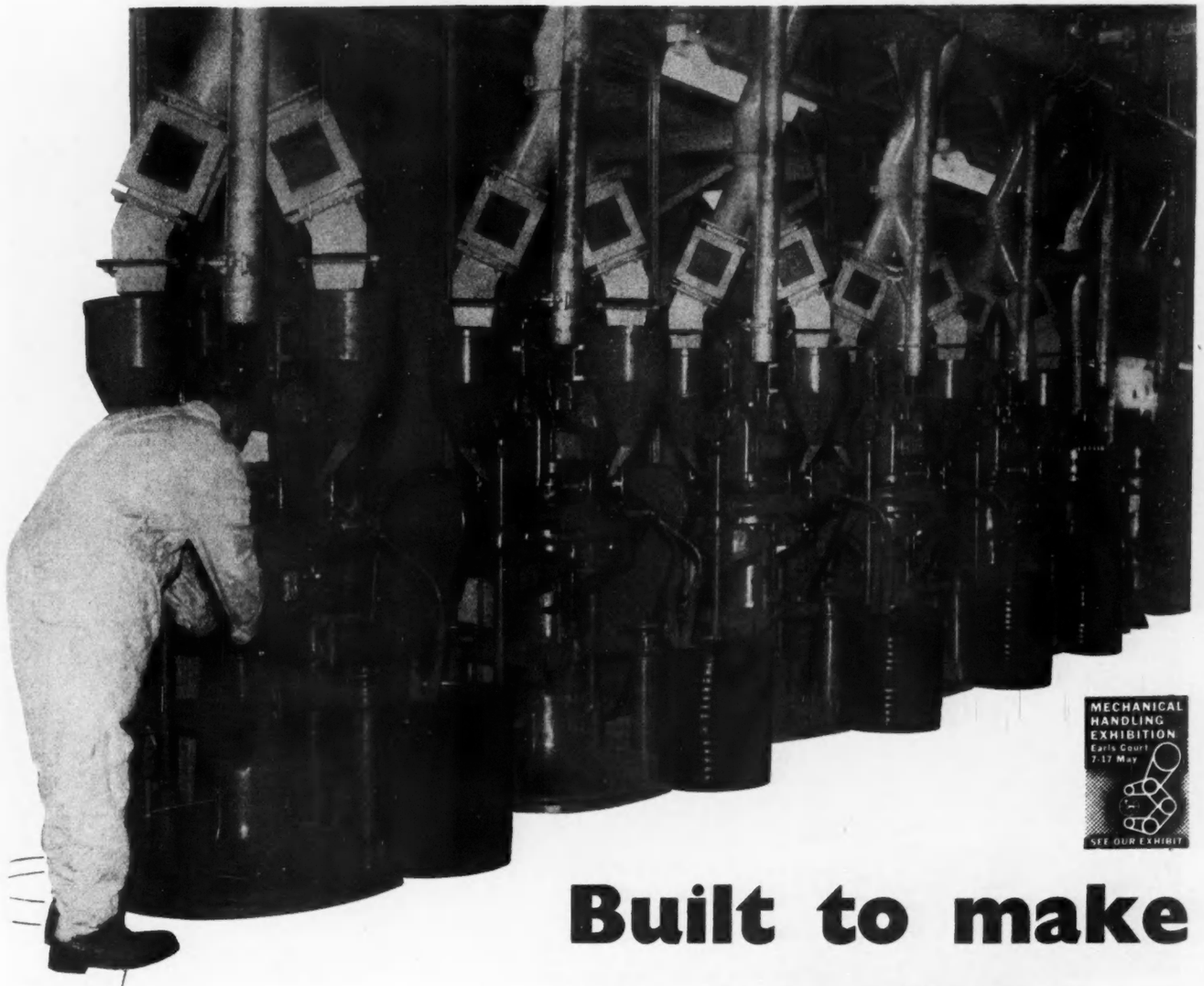

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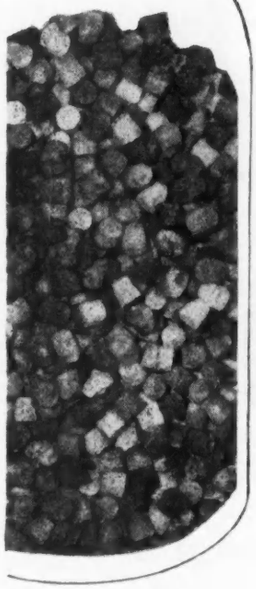

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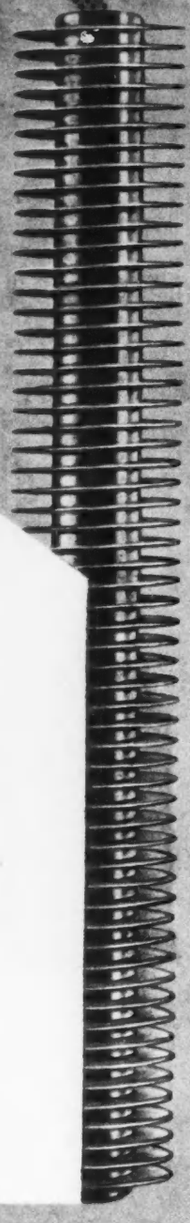

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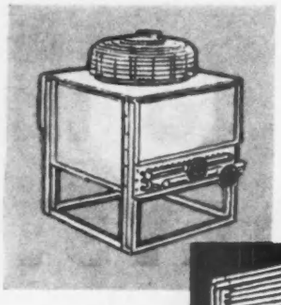

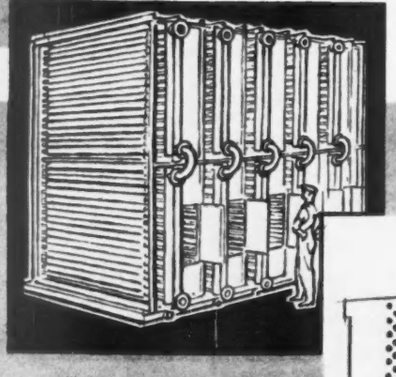

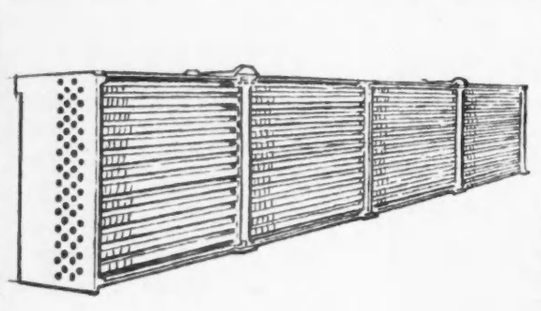

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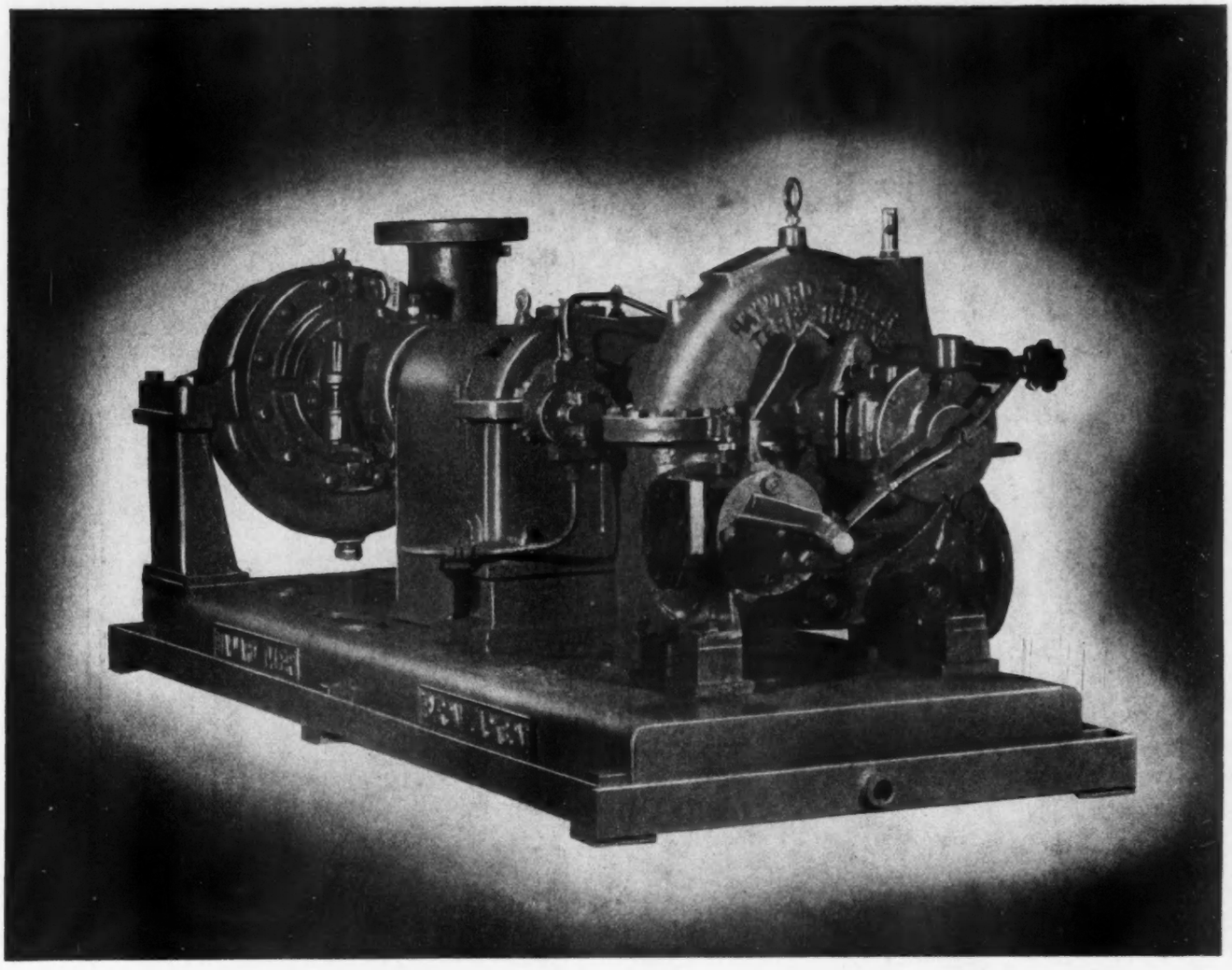

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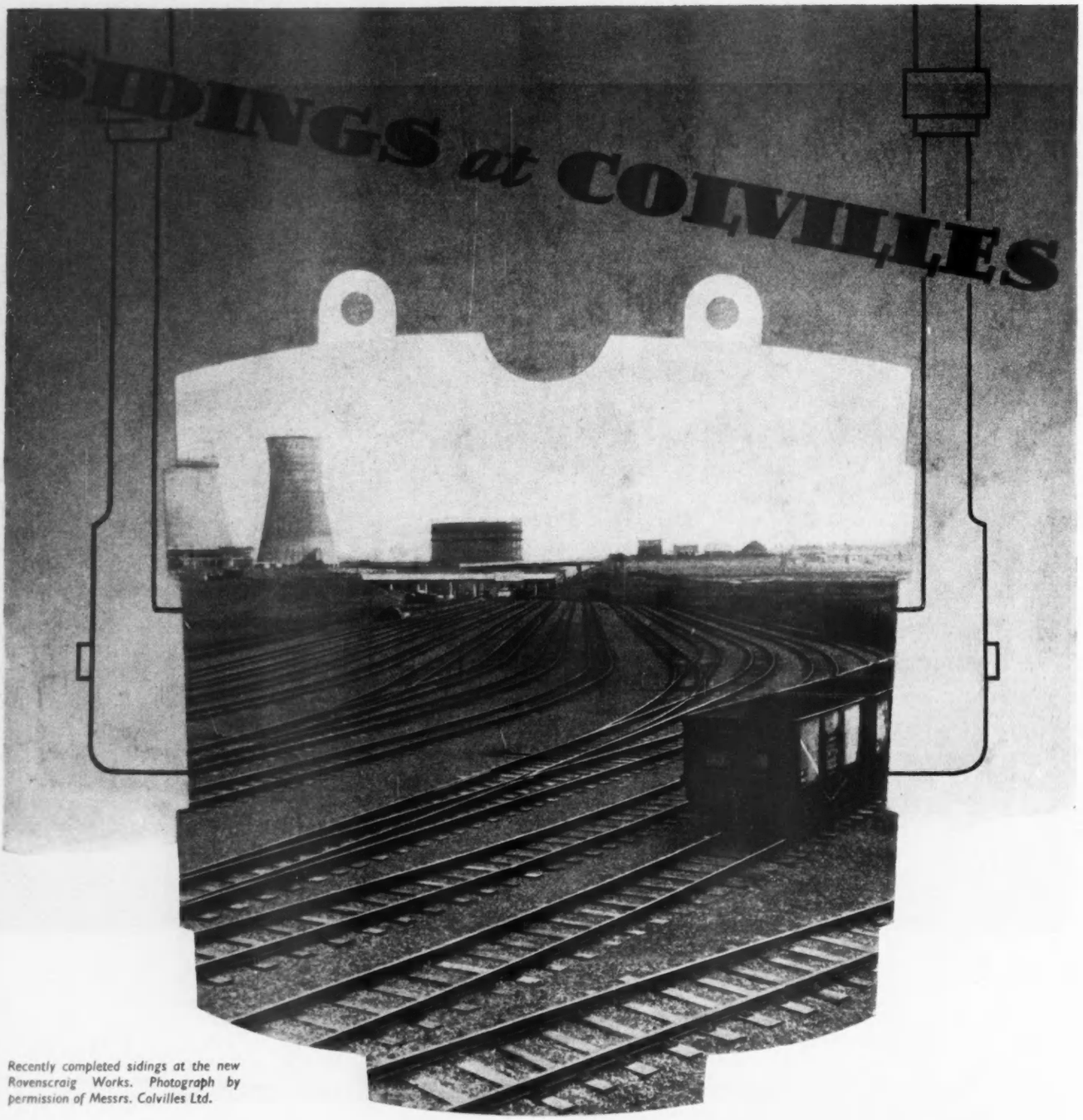

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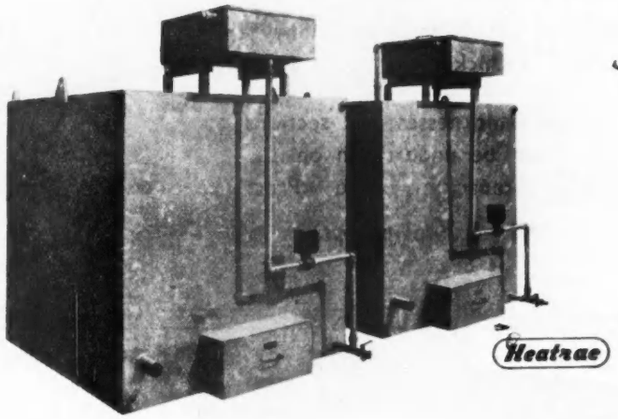

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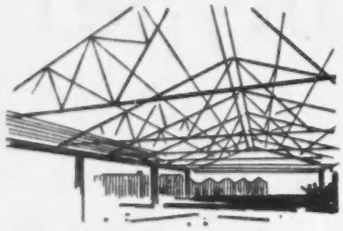

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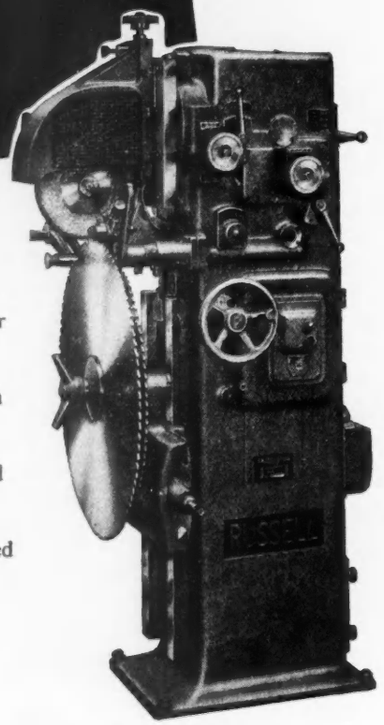

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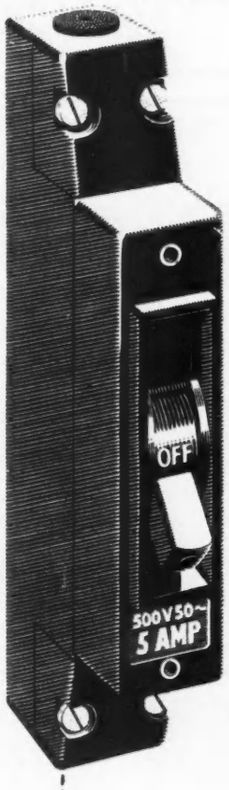
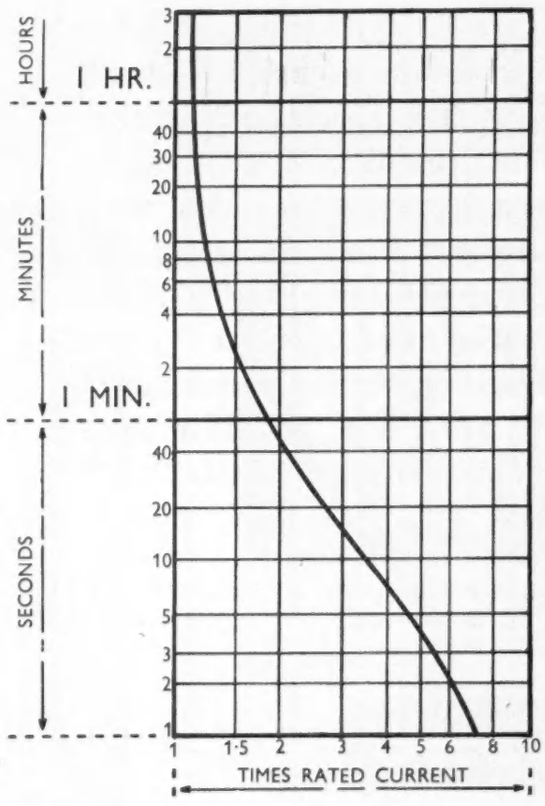
CRABTREE MINIATURE CIRCUIT BREAKERS



CLOSE AND ACCURATE OVERLOAD PROTECTION

The Crabtree Type F-60 miniature circuit breaker is designed to give close and accurate protection at all times. Tripping under fault conditions is achieved by a simple device which, whilst tolerating such harmless temporary overloads as starting surges, will trip immediately the sustained overload becomes dangerous. On heavy overloads or short-circuits, where rapid fault clearance is essential, the Crabtree circuit breaker will trip instantaneously.

Full details of this new product are given in Publication No. 1191, available on request.



Characteristic tripping curve for 60 amp. overload release.

WHY THE USER PREFERS CIRCUIT BREAKER PROTECTION

"Re-closing of the circuit is both simple and safe."

CRABTREE TYPE F 60

A CIRCUIT BREAKER OF UNEQUALLED PERFORMANCE

J. A. Crabtree & Co. Ltd., Lincoln Works, Walsall, Staffs.

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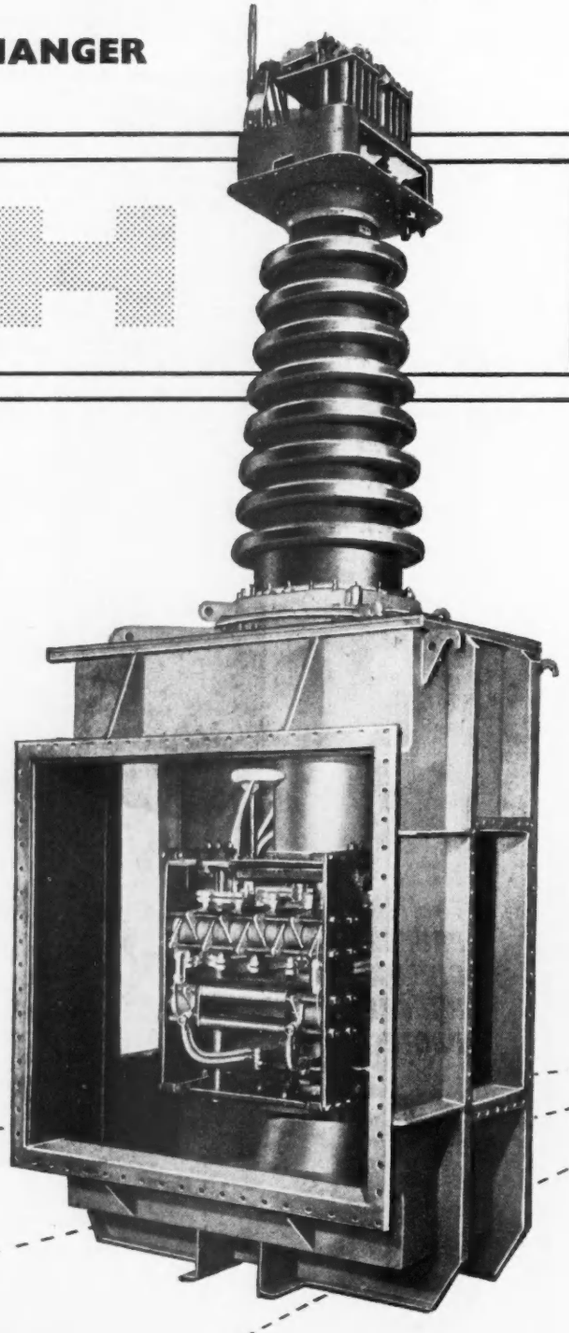
For Service on the Supergrid

TRANSFORMER ON-LOAD TAP-CHANGER

TYPE H



For service at the highest voltages the Type H tap-changer was developed for use with transformers on fully insulated systems. The simple and reliable mechanism ensures completion of tap change, and resistor transition minimises arcing at the transfer switch contacts. Type H Tap-Changing equipment is used by Metropolitan-Vickers and other transformer manufacturers for 120 MVA and 180 MVA auto-transformers for the C.E.G.B. 275 kV supergrid.

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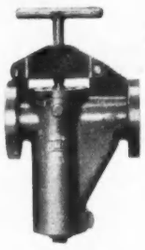

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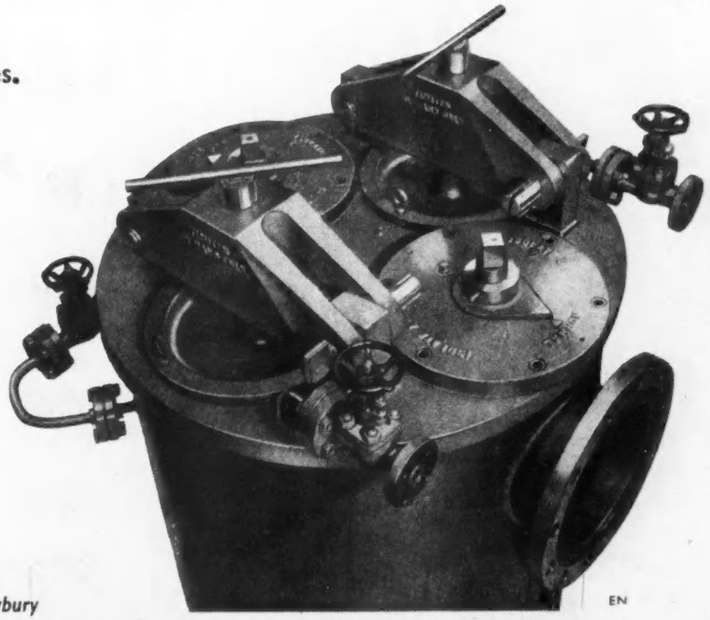

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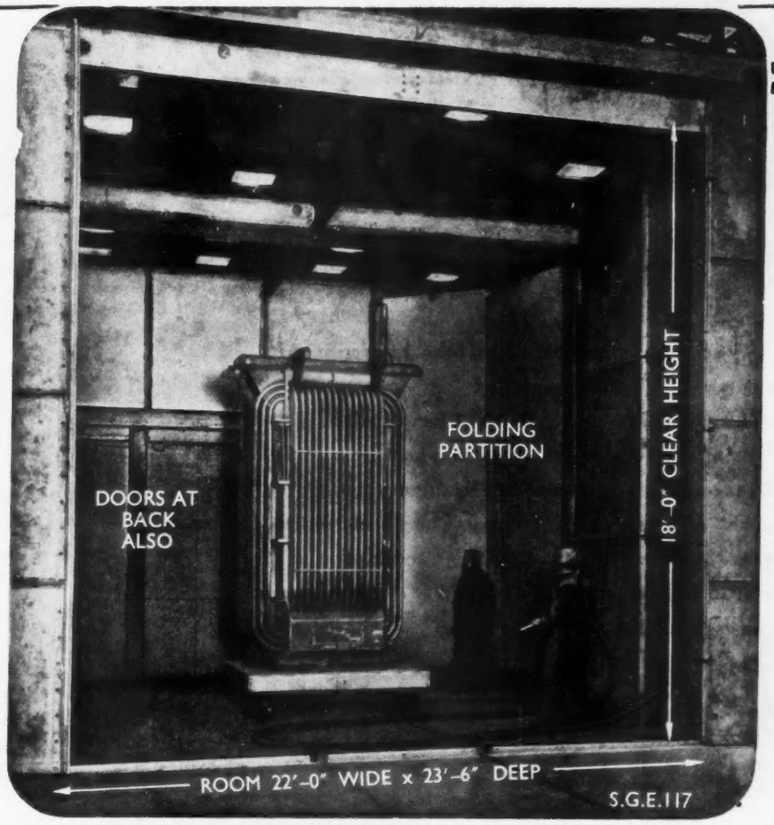

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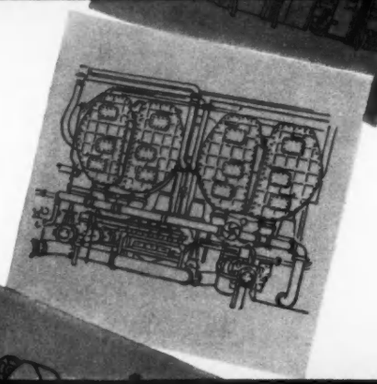

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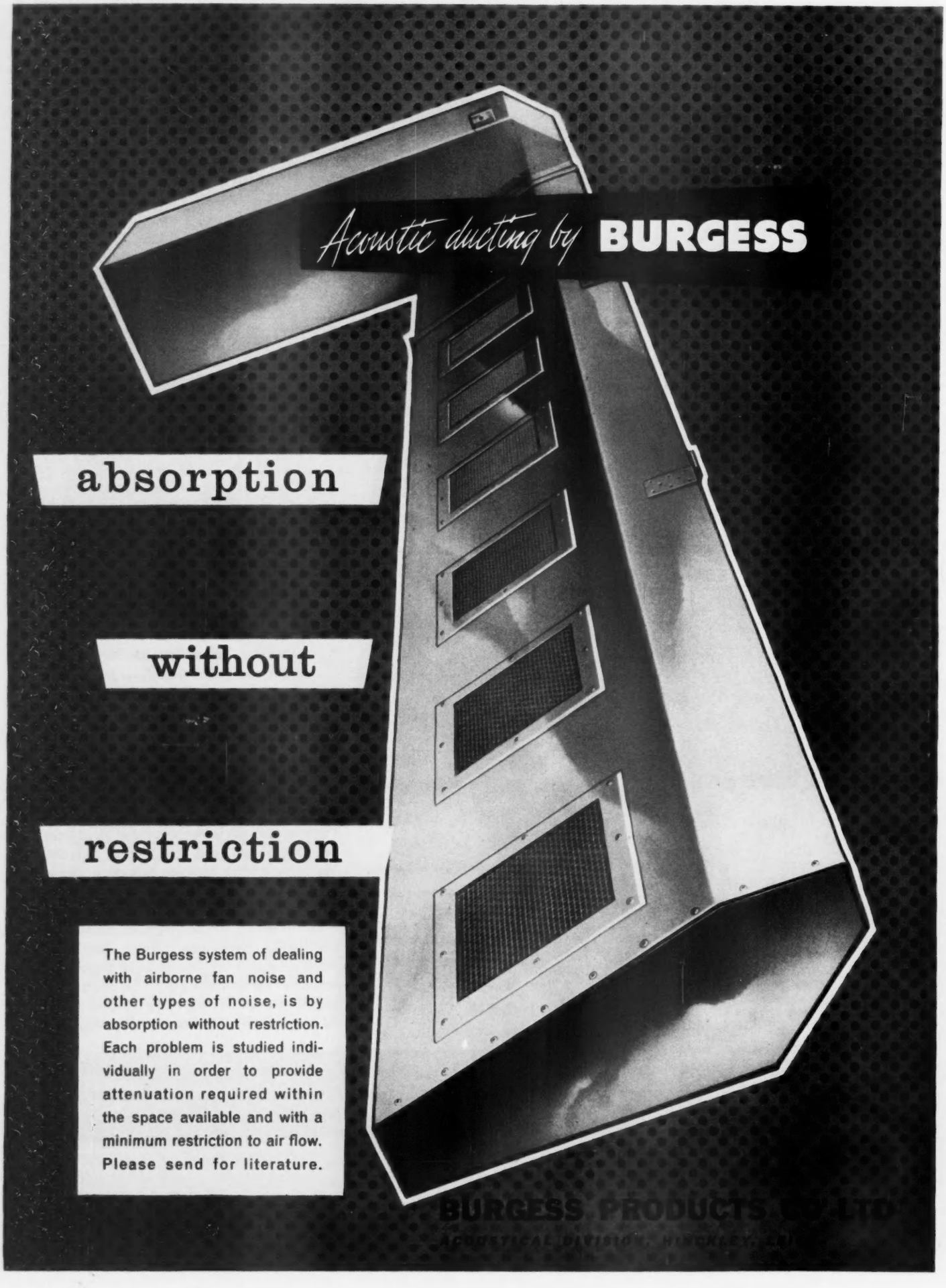
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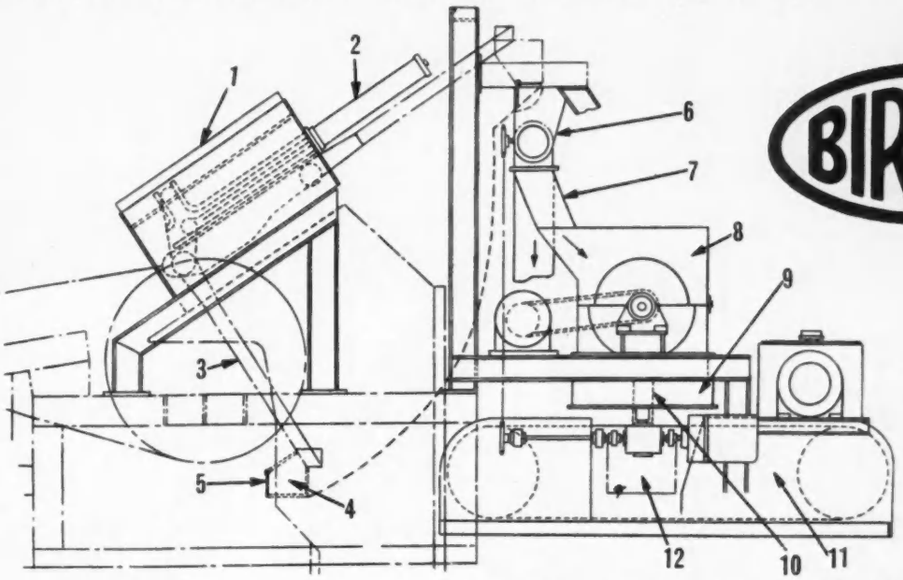

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1 Guide Box*
2 Hydraulic Cylinder*
3 Swinging Arm*
4 Bucket*
5 Hinged Door*
6 Discharge Hopper with Worm—Conveyor feed to crusher
7 Removable chute
8 Crusher
9 Rotary plate-feeder
10 Discharge chute from rotary feeder
11 Slotted belt type secondary sampler
12 Container for final sample

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* Primary Sampler component

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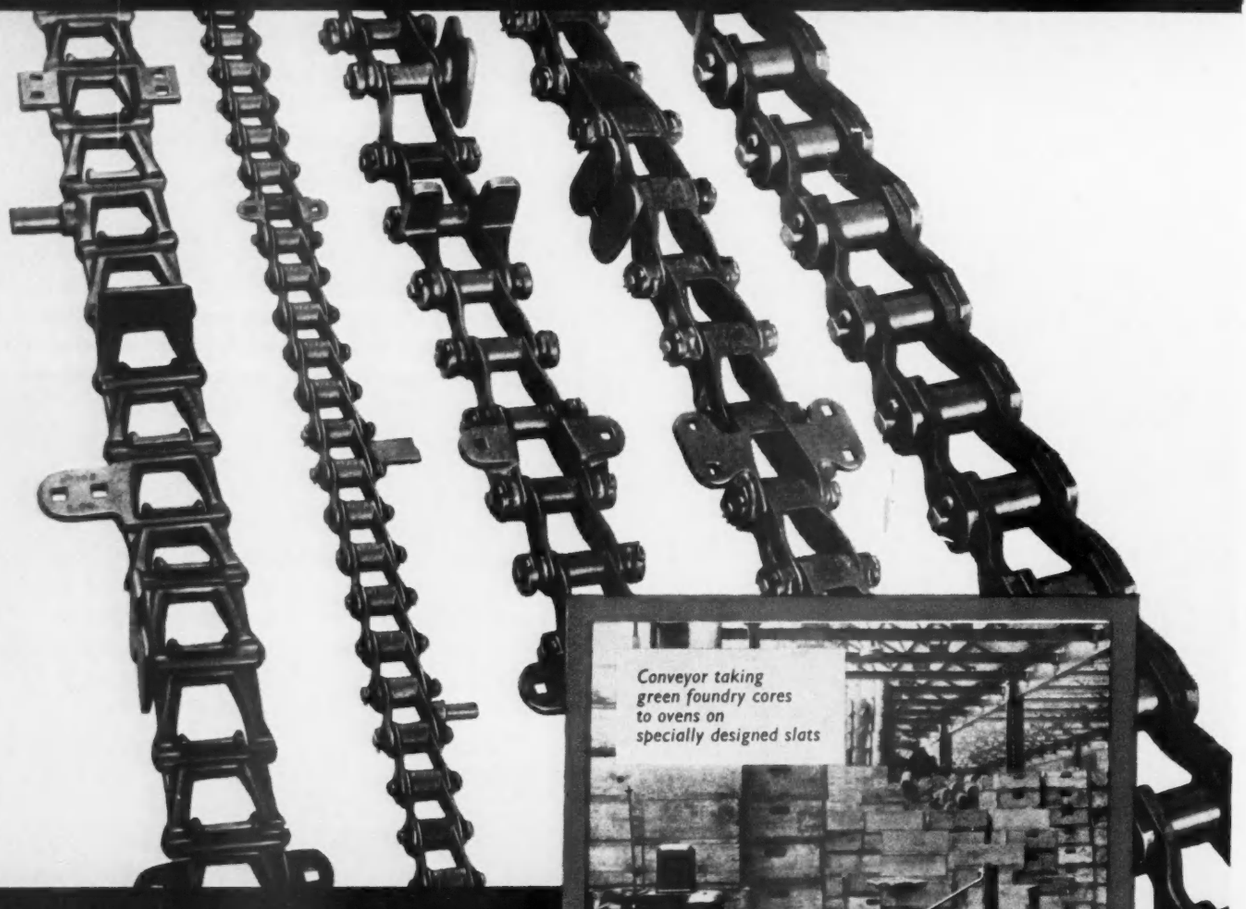

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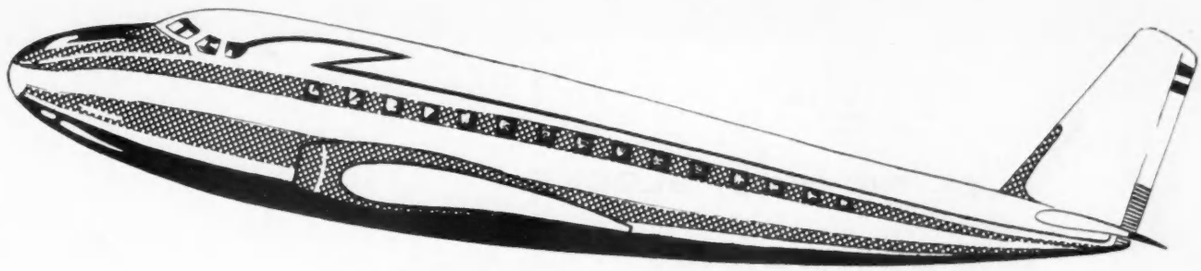

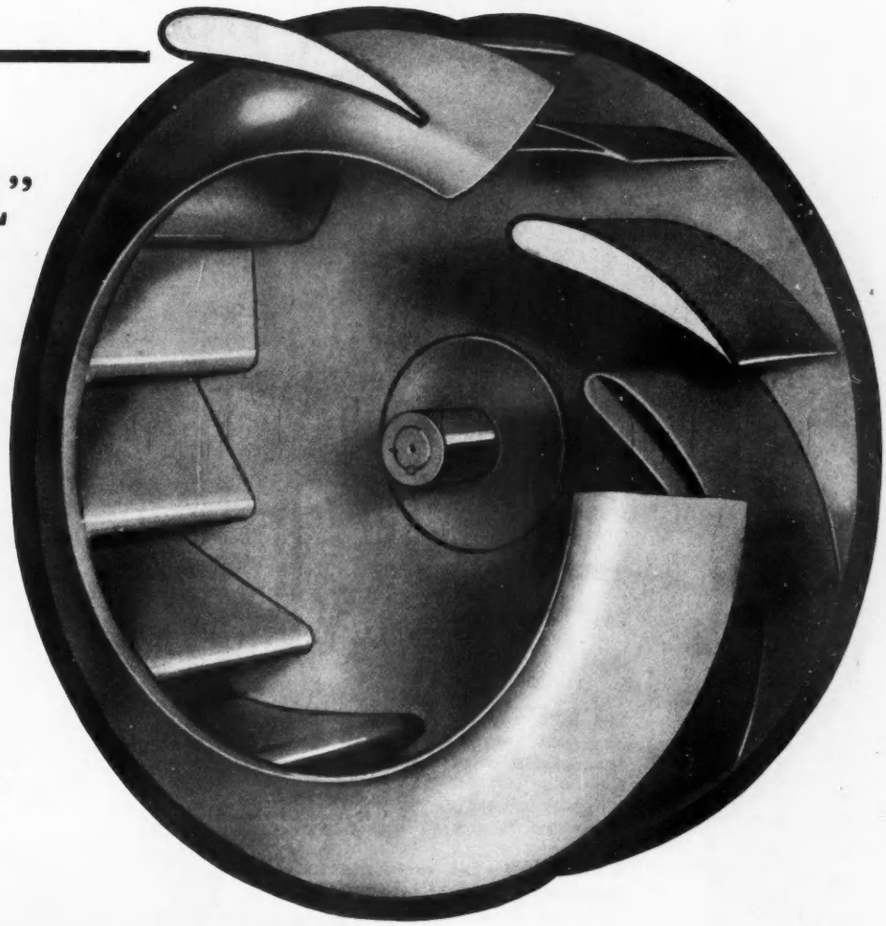

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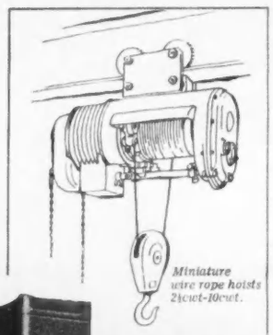
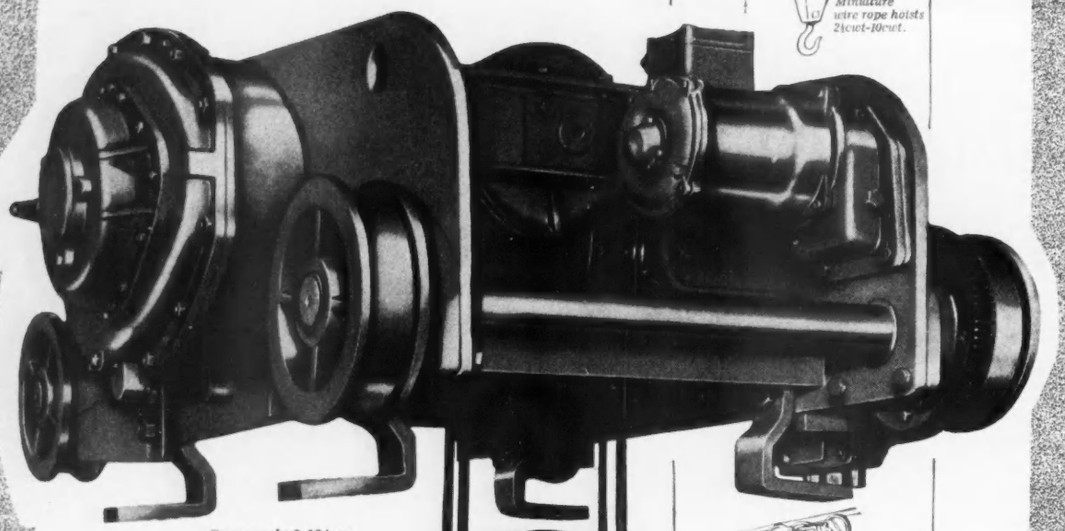
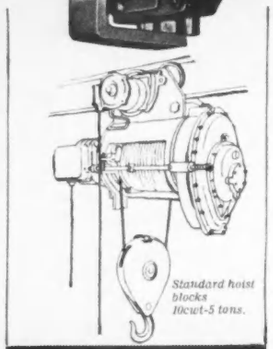
ELECTRIC HOIST BLOCKS AND CRANE CRABS



Miniature wire rope hoists ¼cwt-10cwt.



Crane crabs 3–10 tons.



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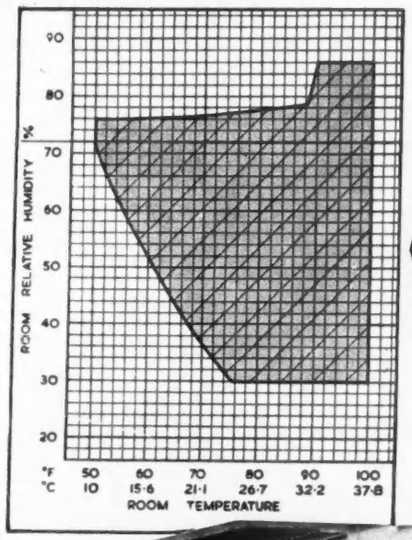
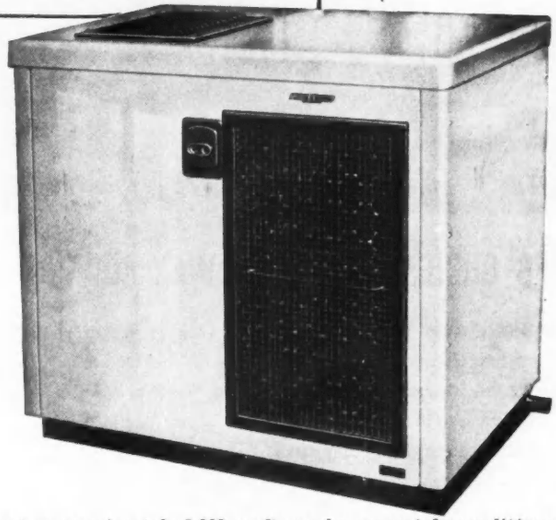


to any conditions within this area



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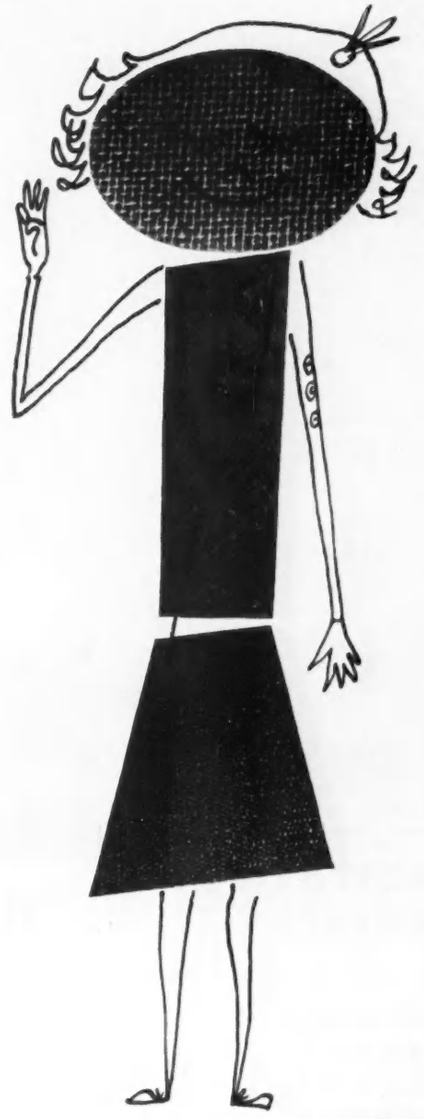

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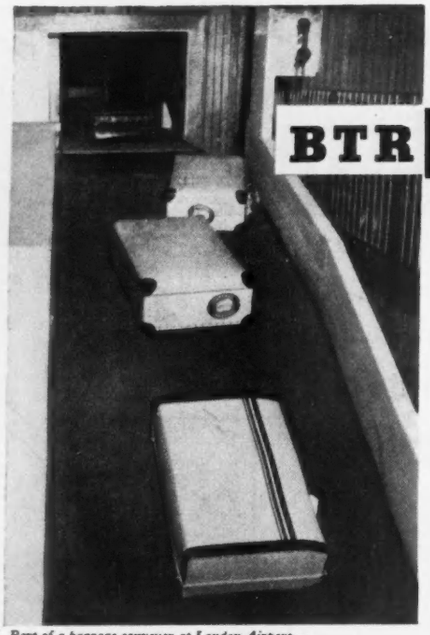
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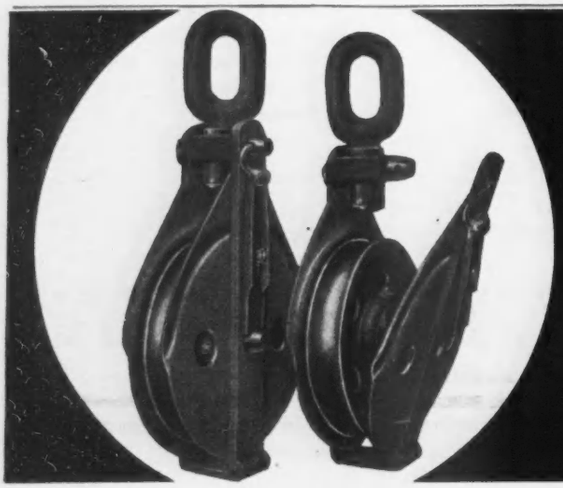

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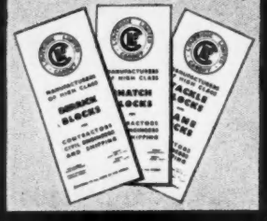

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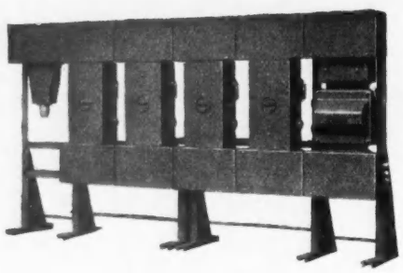

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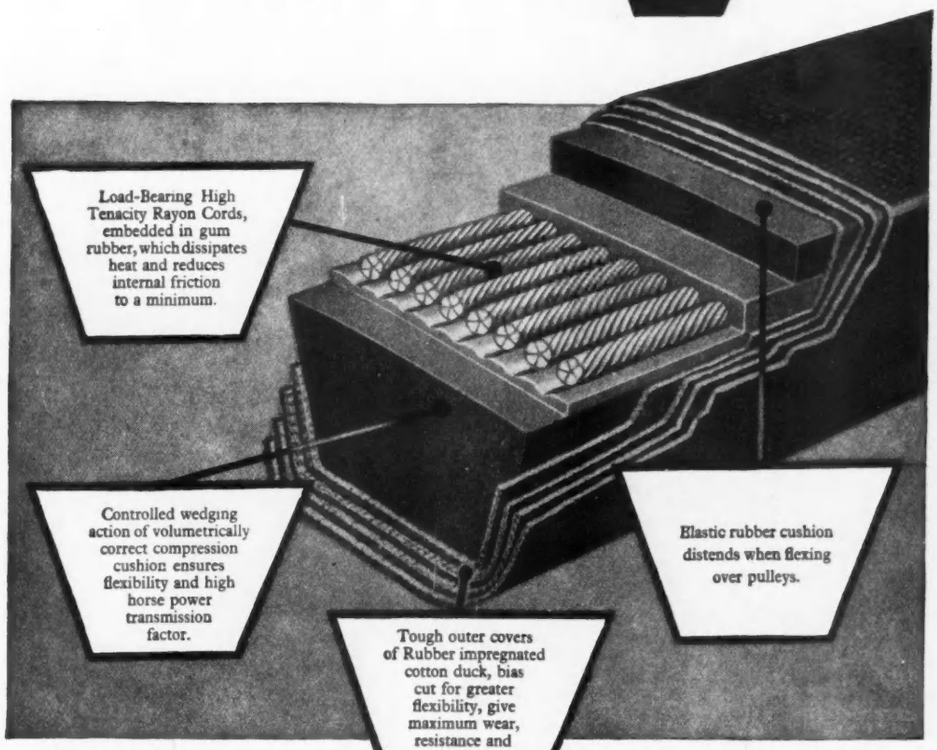
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RENOLD power transmission accessories

Couplings

Sturdy and compact, with the ability to take a reasonable amount of shaft malalignment, Renold Couplings have for many years proved their value on a wide variety of applications—and they are **AVAILABLE FROM STOCK.** For complete information ask for Catalogue Ref. 116/110.

SPIDER TYPE FLEXIBLE COUPLINGS up to 20 h.p.

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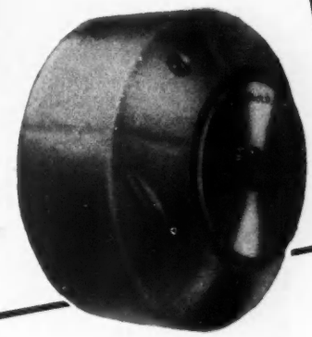

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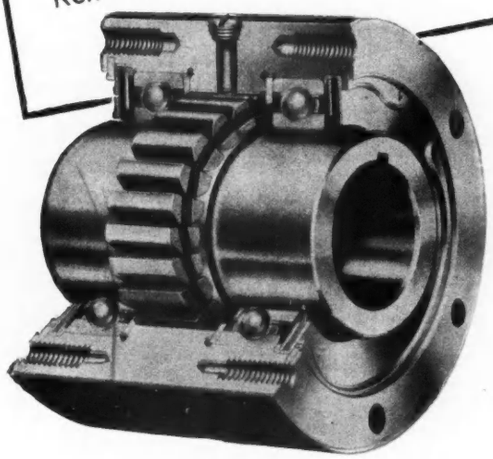

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- **for continuous freewheeling with low drag**
- **for fast and accurate indexing**
- **for backstopping—non-reversibility without backlash**

The Renold Sprag Clutch has many uses in all types of machinery and is ideal for the replacement of noisy ratchet-and-pawl mechanisms. It will give completely positive indexing with speed, accuracy and to unlimited graduations, is capable of high-speed free-wheeling, and will remain free from measureable backlash throughout its life.

Renold Chains Limited are licensed to manufacture Sprag Clutches by Formsprag Company, U.S.A.

Write for Catalogue giving details of our comprehensive range of over 70 standard sizes.

RENOLD —*the FIRST name in precision chain*

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MOLYBDENUM DISULPHIDE ADDITIVE EXTENDS EFFECTIVE LUBRICATION

Molybdenum Disulphide greases are now being employed by all sections of British industry to overcome serious lubrication problems associated with extreme pressures, fretting corrosion, impact shocks, and arduous working conditions where oscillation and reciprocation are involved. Their use results in substantial reduction of wear, much lower starting torque and greatly improved running. This is clearly demonstrated by analyzing the following test data where in all cases the addition of MoS_2 extended the effective lubrication of the base lubricant.

Four tests show how MoS_2 reduces wear

1. SHELL 4-BALL EXTREME PRESSURE TEST

(see illustration top right)—MoS_2 addition reduces wear more than 50% and increases load capacity by about 70% over base grease.

2. FALEX 2-HOUR WEAR TEST

The chart below shows how MoS_2 sustains lubrication, as proved by a reduction of 500 per cent in average wear.

Grease	Loss in Weight of Specimen
Lithium-base	1,000 mg.
Lithium-base plus 2%MoS_2*	1·98 mg-average of 3 runs

3. TIMKEN ENDURANCE TEST

(see illustration bottom right)—MoS_2* sustains lubrication well beyond the capabilities of the base grease alone, and at a lower temperature than conventional E.P. grease.

4. SIMULATED SHACKLE BOLT SERVICE TEST

Oscillating friction machine—3%MoS_2* addition virtually doubles the effective lubrication of a lithium base chassis grease—is far more effective than conventional additions.

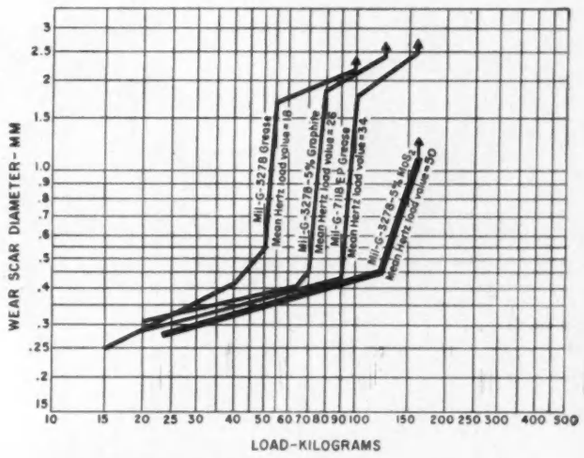
Hours to failure—average of 2 tests

Additive	None	3%MoS_2*	5%ZnO	15%ZnO
Dry	350	564	336	555
Wet	162	264	109	85

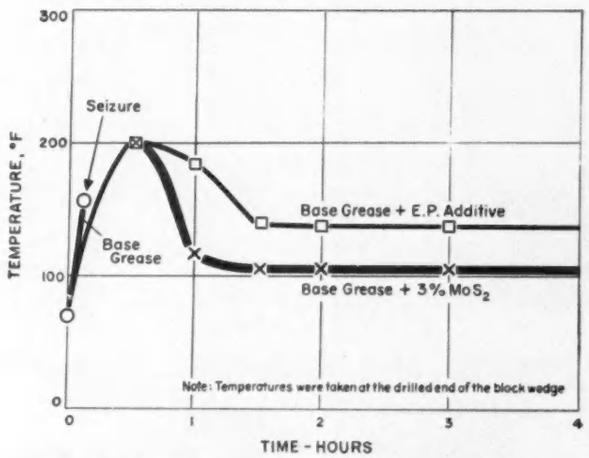
* Fine particle size.

Molybdenum Disulphide greases are manufactured in the U.K. by a number of specialist producers, whose names can be obtained, together with a copy of "MOLY-Sulfide as a Grease Additive", from :—

CLIMAX MOLYBDENUM COMPANY OF EUROPE LIMITED
99 PINSTONE STREET, SHEFFIELD 1


WEAR SCAR DIAMETER - MM
LOAD - KILOGRAMS
Mil-G-3278 Grease
Mean Hertz load value = 18
Mil-G-3278-5% Graphite
Mean Hertz load value = 26
Mil-G-7118 E.P. Grease
Mean Hertz load value = 34
Mil-G-3278-5% MoS2
Mean Hertz load value = 50

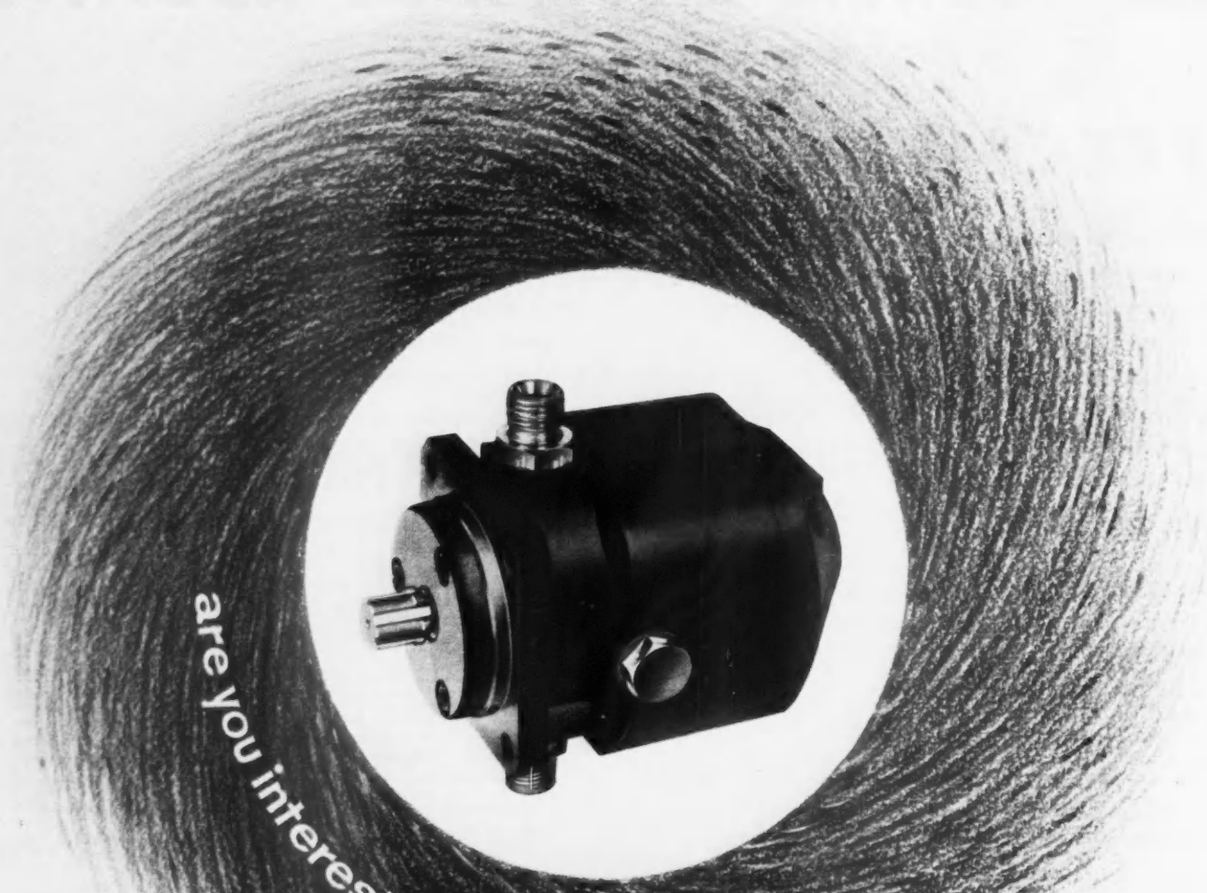
4-ball E.P. test shows the superior extreme pressure properties of MoS_2 grease over the same grease without additives. In the same test, grease containing 5% graphite had a mean Hertz load value of 26: the conventional E.P. grease Hertz value was 34.


TEMPERATURE, °F
TIME - HOURS
Seizure
Base Grease
Base Grease + E.P. Additive
Base Grease + 3% MoS2
Note: Temperatures were taken at the drilled end of the block wedge

Timken endurance test clearly shows how MoS_2 functions when added to a base grease. With base grease alone, the specimen seized in about 10 minutes. With MoS_2 added, lubrication was effectively sustained throughout the test at a reduced temperature of about 100°, compared with a temperature of about 130° for the conventional E.P. grease.

MOLY-SULFIDE†

†*MOLY-Sulfide is a Climax brand name*



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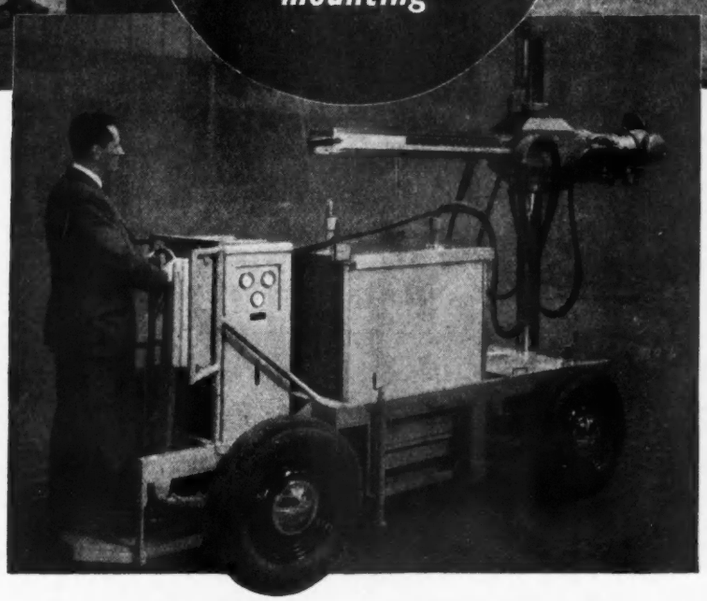
The Tubehead of the Marconi 250 kv Constant Potential X-Ray Generator has a range of different mountings to suit your needs

Let Marconi Engineers assist you in your choice of mounting



(Above) Attached to the Extending Suspension mounting running on overhead rails, the Marconi Tubehead can be manipulated with ease over the largest components, as for instance, the one-piece cast steel bogie frame shown. *(Photo by courtesy of the English Steel Castings Corporation Ltd.)* (Left) The Self-Propelled Mobile Mounting may be manoeuvred about the shop floor, an armoured flexible cable providing connection to the static control unit. *(Photo by courtesy of W. J. Fraser & Co. Ltd. (Chemical Engineers).*

X-RAY EXAMINATION WITH VERSATILE MARCONI APPARATUS SAVES TIME — MONEY — AND REPUTATIONS

Industrial Radiography provides industry with a non-destructive means of verifying that welded or cast components are free from internal flaws. Radiographic inspection before machining often saves time and money — and is an assurance that safeguards your reputation. Marconi Instruments offer a versatile X-ray installation suitable for an extensive variety of applications in the engineering industry—ask for leaflet AJ14.

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IXI4R

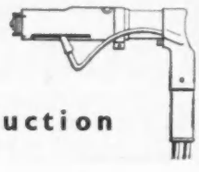
That's the ticket

Look closely at the railway coach you ride in and you will probably find that it features Crompton Parkinson stud welding. Examine the signal gantries it passes and you will certainly come across stud welding again. And, if you were to delve really deeply into the matter, it is more than likely that you would discover it once more on the pit-props in the mine that provided the coal required to provide the electricity which drives the train.

What C.P. stud welding does for the railway, it does for industry as a whole — reduces costs, simplifies designs and speeds production. It's a sure way to greater productivity — and a permanent way at that! Do you know all about the advantages of stud welding? If not, we shall be glad to put you on the right lines.

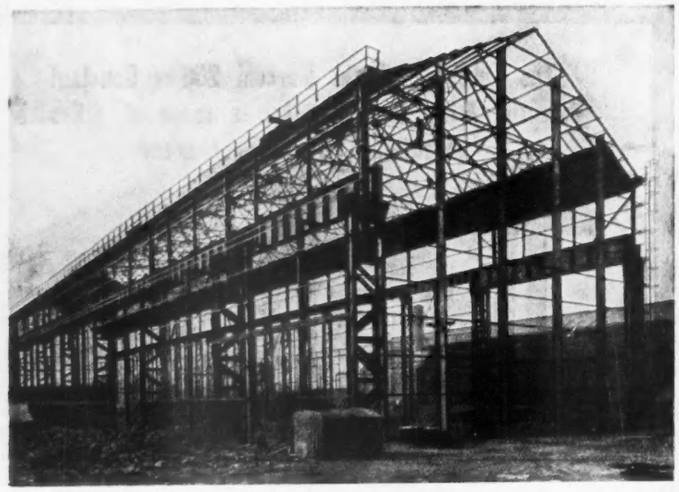
Crompton Parkinson
(STUD WELDING) LIMITED

1—3 BRIXTON ROAD, LONDON, S.W.9. Telephone: Reliance 7676



Stud welding steps up production

Structures in Steel



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MACHINES

All machines in our range are available for demonstration at our works at any time.

MACHINES FOR SPOT · STITCH BUTT and SEAM WELDING

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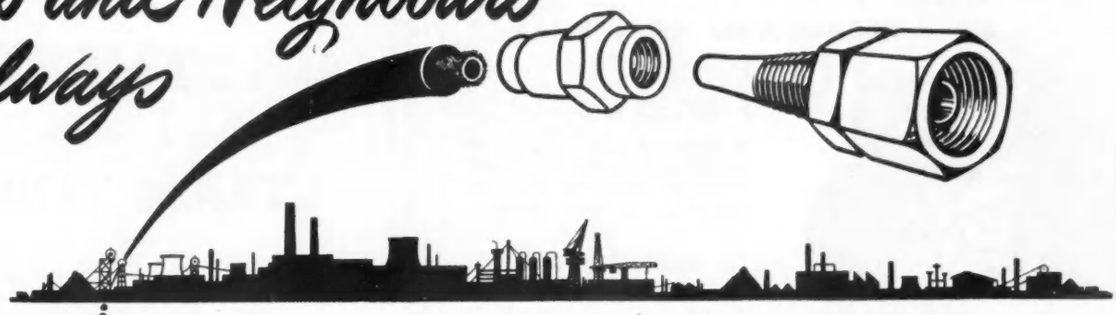

. . . when you've got a broken hydraulic line on your hands! But a small stock of Hi-Flex Hose and Self Fitted Couplings will enable you to make up your own Hose assemblies on the spot. Deal with emergencies as they arise and keep valuable machinery in Service.

These Hi-Flex Couplings are Self Fitted and can be re-used and are supplied in sizes from ⅛" to 1½" I/D to fit all British and American threads. Equipment requiring special ends can be supplied to customers own specification.

The Technical Advice of our Representatives is available to you at all times.

...but 'HI-FLEX' self-fitted couplings *can!*

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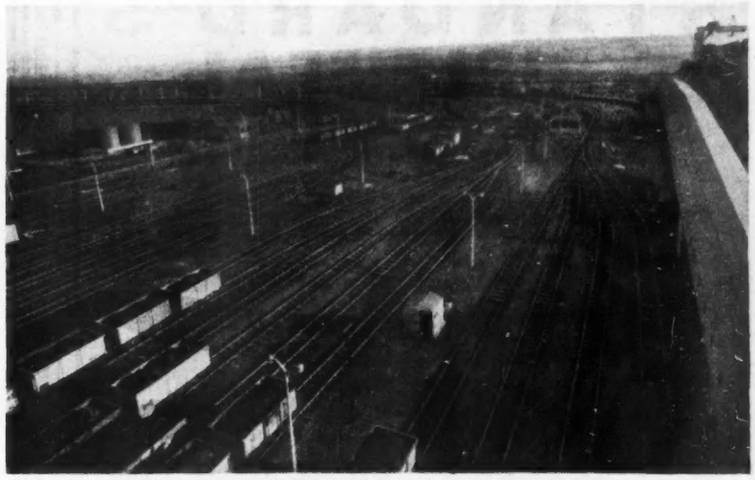
MANVERS CENTRALIZATION SCHEME :

From the top of the newly constructed Coal preparation plant: a small section of the immense network of railway sidings

The supply and installation of these sidings and the adjoining trackwork for the new Coal Carbonization and Benzole Rectification Schemes were entrusted to the Eagre Construction Co., Ltd., by the National Coal Board. Over 9,000 tons of Iron and Steel were used in the construction of the forty miles of track and 230 turnouts and Special Point and Crossing layouts comprising the combined railway Sidings.

Eagre's skilful planning and practical experience in the day-to-day working of Colliery Sidings ensured that this vast scheme was laid efficiently to schedule, and without the slightest interruption of existing Colliery traffic.



Photograph by courtesy of National Coal Board

WORK BEGINS AT CADEBY :

The National Coal Board again entrusts the Eagre Construction Co. Ltd. with a similar project. Earthworks, Drainage, Track Laying and ancillary works for thirteen miles of Sidings are now in progress at Cadeby Main.

for a complete Track Service

Photograph by courtesy of National Coal Board

In addition to its activities in the Nation's Coalfields, the Eagre Construction Co. Ltd. has worked continuously during the past ten years for British Railways, the Gas Board, the United Steel Companies, and has carried out large Power Station Projects for the Central Electricity Authority.

SURVEY
DESIGN
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Whatever the magnitude of your siding requirements, be sure to consult

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REPAIR AND MAINTENANCE FOR FACTORY FLOORS and ROADS

A revolutionary method of repairing concrete floors and roads in factories with the minimum of inconvenience.

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Concrete floor section prepared by The Mettexture Process to receive a new topping. The remarkable bonding made possible by this process enables very thin toppings to be used with economy and complete assurance.

It PAYS to know about ★ *The Mettexture Process*

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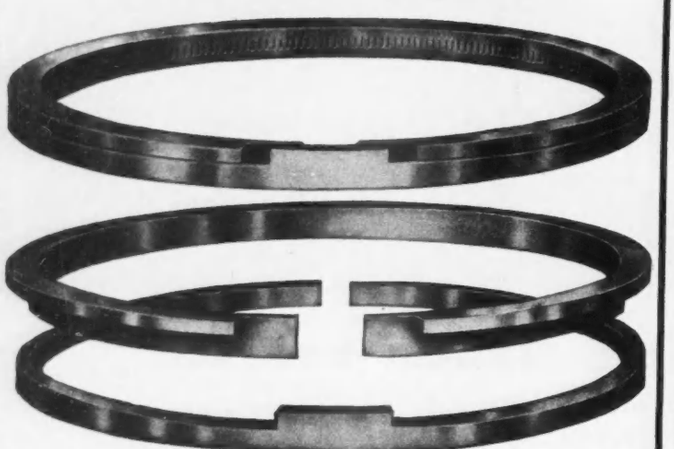
STANDARD'S TRIPLE SEAL PISTON RINGS



EFFECTIVELY SEAL THREE FACES

Eliminate by-pass, Restore compression, Maintain full power, Function until bore of cylinder is worn by as much as 1%.

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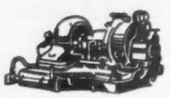

Wide range — all types. Over 50 years' experience. **Hundreds in hand— thousands in service.**

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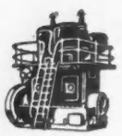

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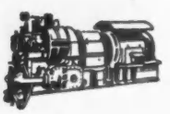

Turbine driven up to 11,000 KW. Engine driven up to 340 KW. **Scores in hand, hundreds in service.**

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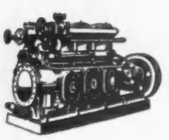

Ammonia, CO_2, Freon, Methyl, Chloride, SO_2. Wide range— single and double acting—one or more stages. **Made to measure for special duties.**

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All types. Nearly 50 years' experience.

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PLANT TO CUSTOMERS' OWN DESIGNS

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We shall be pleased to investigate them confidentially without commitment

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COMPRESSOR & POWER PLANT SPECIALISTS FOR NEARLY A CENTURY

MORE POWER

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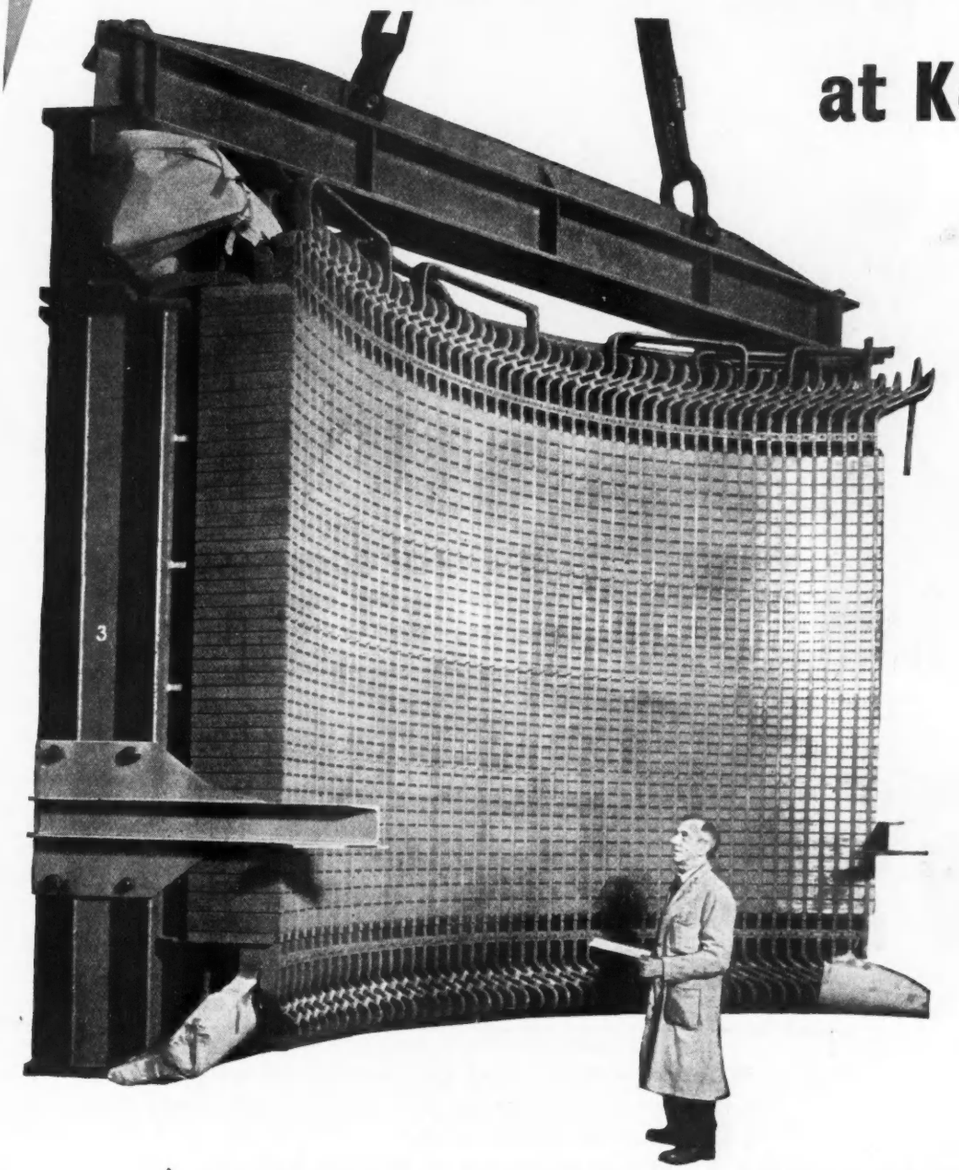

A repeat order for an alternator for the Kitimat project of the Aluminum Company of Canada has recently been completed. This machine is rated at 114,000 kVA with an overload rating of 132,000 kVA.

The photograph shows a section of the stator of the second machine ready for packing in the works.

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1 Easy to fit—only two spanners required.
2 Positively re-usable. Can be used time after time.
3 No need to strip rubber from hose-end.
4 Robust design: will stand any amount of hard wear.
5 Will hold higher pressures than the hose itself.
6 Available in single units up to 60 ft. long.

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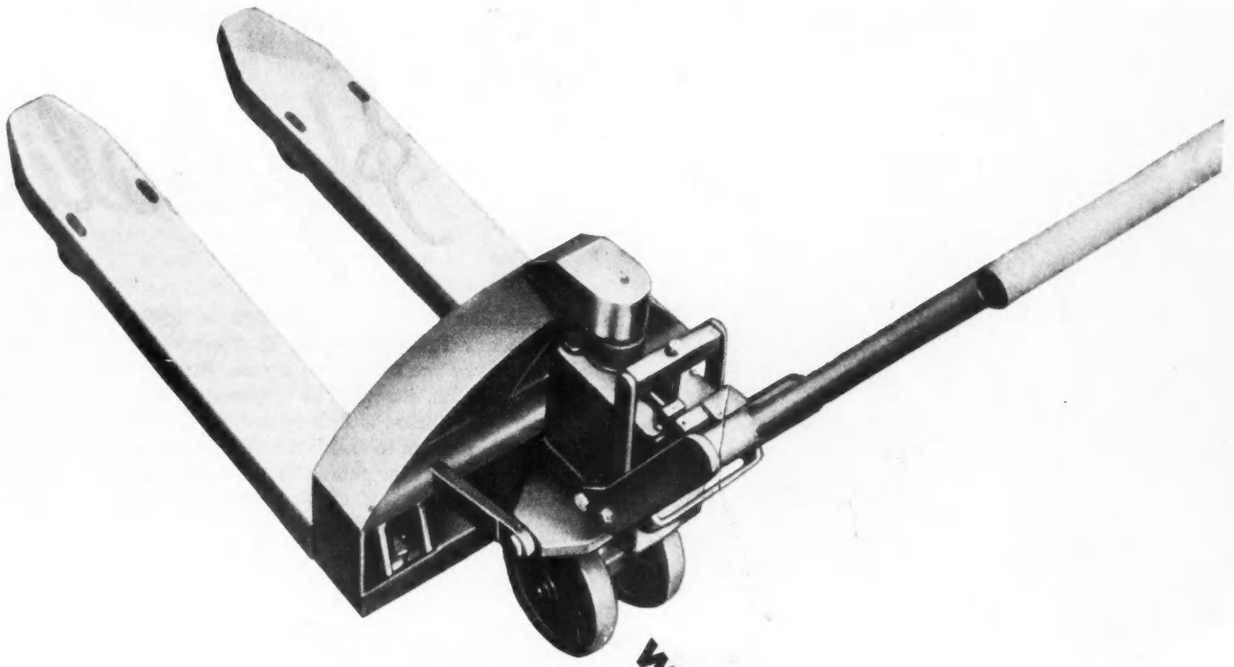
Ermeto high pressure flexible hose units can be supplied for hydraulic, steam, and chemical uses. Further particulars and prices gladly sent on request.

BRITISH ERMETO CORPORATION LTD Beacon Works Hargrave Rd. Maidenhead Berks



WHEELS WITHOUT WEAR

Here's a simple idea that saved one Works Manager £50 per truck, per year, on concrete floor repairs alone. He fitted out the trolley fleet with wheels made from TUFNOL, the non-metallic, engineers' material. Exceptionally strong and light, TUFNOL wheels wear surprisingly well—yet *do not* wear the floor surfaces on which they run. Take this Portapal Pallet Transporter . . . its TUFNOL wheels run smoother, more quietly, last longer, and reduce floor wear—however heavily it's loaded.

You can make your own trolley-wheels—and a wide variety of other components—from TUFNOL sheet or blanks; or we will gladly produce them to your specification. Ask for an engineer to call.

MAKE THE MOST OF TUFNOL

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An ELLISON Product

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517

NOW 100 TONS CAPACITY

Hydralite

The latest addition to this standard range of light-weight Hydraulic Jacks incorporates a new Tangye two-speed hand pump (A); the two speeds giving high or low pressure are selected by a push button (F). When the button is in an 'OUT' position, the ram can be pumped out rapidly and raise a load up to 10 tons. The button is then pushed to 'IN' position, when the pump operates on high pressure to enable the raising of up to 100 tons on the ram. Pressure release to lower the ram is by hand wheel (B) which operates a sensitive needle release valve and allows a controlled descent of the ram under load. The power lift is 6 in.

Other items: (C) provision for pressure gauge or pressure supply connection; (D) oil filter; (E) cistern vent; and (G) operating shaft.

TANGYES LIMITED
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No. Ad. 51

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... to be solved by **Paterson** *plant for pure water*

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THE ENGINEER

No. 5338 MAY 16, 1958 VOL. 205

NEW BROOMS FOR RESEARCH

Unexpectedly the first Report of the Research Council of the Department of Scientific and Industrial Research for 1956–57, issued a few days ago, turns out to be quite an exciting document. It will be remembered that this body took the place of the former Advisory Council in November, 1956, having been substituted for that Council, and having had conferred on it executive powers which the Advisory Council did not possess, by the Department of Scientific and Industrial Research Act of 1956. Perhaps there is something in that old adage about new brooms after all ! At least the new Research Council has already started up fresh lines of thought about the purpose and organisation of Government-financed and Government-assisted research. It has been asking itself some very pertinent questions during its first year of service, such as : " What part should the Department play in the conduct of pure research ? " and " What part should its own stations play in research of direct application to industry ? " These two questions have been the first to be studied. But two other questions are recognised to need study later. They relate to the way in which limited resources should be allocated and to the extent to which industry can be expected eventually (if at all) to shoulder the whole cost of adequate research programmes in grant-aided research associations. A much clearer conception of the way things should be organised is beginning to emerge.

On the first two questions—those to which primary consideration has been given—certain conclusions have already been reached. For example, it is considered that the universities should remain the main centres of pure research, though a modicum of pure research to support their own applied work, or to extend the work done by universities, can still aptly be done by the Department's stations. One consequence of the Council's conclusion upon this point is that already grants recommended to be made to universities for special researches have risen much more in the year under review than in previous years, for example, up to £836,000 for 1957–58 compared with £400,000 in the previous year. Study of the second question—that relating to the part the Department's own stations should play in research of direct application to industry—is incomplete. But it is already clear that the Council believes some of the work being done in the Department's stations would be better done elsewhere. Advantage, for example, is to be taken of the fact that the Fuel Research Station is to remove from Greenwich to Stevenage in the autumn of this year to reorganise its work. It has been apparent to visitors for a long time that much of the work in progress at that station has been duplicated at other stations and at the works of individual firms. The intention, therefore, when the move is made, is to concentrate the work on projects " which are clearly of national importance but are not being carried out elsewhere." Amongst them will be work on air pollution and upon the synthesis of oil and chemicals from carbon monoxide and hydrogen. Additionally, the new station at Stevenage is to take up research in mineral processing and it is intended to become versatile enough to pioneer research in almost any new field for which its equipment would be reasonably suitable. There will thus be created quite a new kind of research body and one which should prove peculiarly attractive to research workers.

The Council is at pains to stress in its report that where it favours change it is not finding fault with the way stations are conducting research. But it believes—and, we feel, rightly believes—that a redistribution of effort is desirable and that there is at present a certain amount of unnecessary duplication. The impression given is that the Research Council is moving towards the conception that the more directly applicable research should be undertaken by research association stations, that most of the pure research should be done in universities, and that the Department's own stations should concentrate more nearly upon pioneering research and upon researches, such as those into air and water pollution, for example, which no research association is likely to regard as falling within its field.

THE FUTURE IN THE AIR

The amount of anticipation which preceded the announcement this week of the policy of the Government towards the aircraft industry is likely to be rivalled by the amount of speculation as to what precisely Mr. Aubrey Jones's pronouncement means. The Government, the country is told, will continue, *as necessary*, to sponsor and finance aeronautical research and development to enable the industry to meet the Services' requirements for aircraft and guided weapons. It also intends to continue to pay all or part of the cost of additional research needed to maintain the industry as a mainstay of the economy and a pioneer of technological progress. The Government anticipates, however, that the industry will become stronger rather than weaker in the changed conditions of the future, and looks forward, indefinitely far, to a time when the industry, much more than the taxpayer, will support the Government research establishments. Nevertheless, the Exchequer may assist financially in the development of some future civil aircraft. It all sounds decidedly vague !

This policy seems so remarkably lacking in inspiration and clarity that it is difficult to believe that even an inter-departmental commission could have needed nine months to bring it forth. However, it seems that at least some decision-making has taken place. The Minister has added that the general level of expenditure on research will remain roughly as at present : this allocation, as we understand it, will have to suffice also for such researches as are needed for ballistic missiles and allied projects, most of which are at present engineered by firms in the aircraft industry. Since the latter activity will have to be either abandoned or supported on a rapidly increasing scale, the money available for strictly aeronautical

researches may thus be curtailed quite sharply. The effect of this policy over, say, five years, the Minister anticipates, may be a reduction in the labour force of the aircraft industry from 250,000 to about the figure of 150,000 pertaining before the Korean war, and possibly only two engine manufacturers and three or four airframe companies will then retain a separate existence.

It seems to be generally accepted in British industry that a home market for a substantial portion of the output of any one industry is essential, so that, since this country is a small user of aircraft, we must expect to have a small aircraft industry. It is, however, disquieting to contemplate the effect a policy such as that outlined by the Minister may have upon our national security. The Minister has indicated that support for the variable-sweep "Swallow" project of Dr. Barnes Wallis was withdrawn at the research stage because there was no requirement for supersonic bombing—or, presumably, reconnaissance—aircraft; and that it will not be renewed unless another application for such an aeroplane is proposed and approved. But this decision surely reverses the proper order of things. Until there is a basis of observed fact it is not possible to decide whether a requirement is too easy or too advanced for the engineers, in the time available, to meet it; and the forecasting of requirements is so difficult that there is seldom or never time to do fundamental research after those requirements have been formulated. We have previously given voice to our belief that the reason for the abandonment of the British supersonic bomber project was that it was irredeemably behind schedule even before a flying scale model—a "707" equivalent—had been initiated, and this may have been due not only to delays in decision-making, but also to the absence of an accumulation of aerodynamic experience in contemporary regimes of performance. It is when such critical decisions have to be made that the really fundamental objection to a single procurement authority, the Ministry of Supply, becomes ominously obvious. One single mistake on its part can have consequences as bad as or even worse than, the abandonment of the Vickers "1000" in the days of faith in the turbo-prop transport. It is worthy of serious thought that one of the two most trenchant reasons given, by critics in the United States, for their technology being rivalled of late by that of another nation is that the development of, for instance, engines, has been directed to meet previously ordained requirements instead of being pushed ahead as fast as the state of the art could be advanced. The other, of course, is the constant level budget for research and development.

TENDERS FOR WATER TURBINES

It may be a surprise to many of our readers to learn that competitive tenders have not been sought for the water turbines of the North of Scotland Hydro-Electric Board's schemes up to the present, though such tendering is now to be introduced. The Board's chairman, Mr. Thomas Johnston explained the situation in a speech he made when opening a new extension of an engineering works at Alloa at the end of last month. "Away back in 1945," he said, "when the Board was beginning its vast operations, it discovered that there were no firms manufacturing water turbines in Scotland. In England there were only two firms with no home market who were spasmodically manufacturing for an export market. Other sources upon which we might have had to fall back for possible supplies were the Continent and the United States of America. Well, we made up our minds that so far as we could jolly well organise it, we were going to stimulate the supply of water turbines by Scottish labour and Scottish enterprise—allocating shares of our orders—so we encouraged the two English firms to come up to Scotland to manufacture their turbines. The English Electric Company came to Scotstoun and Bovings came to manufacture at Kilmarnock and Clydebank. The Harland Engineering Company here in Alloa, was also quick to realise the possibilities with the result that it has shared the £3,750,000 that the Board has so far spent on water turbines, its orders having topped the 220,000 h.p. mark, 78 per cent of this total output having been for the home market, i.e. for the Board." Mr. Johnston went on to explain that with the steady demand thus created at home, exports of water turbines had been increased by all these firms. Then he said: "Well it is now urged upon us by a committee on nationalised industries in the House of Commons that the 'know how' having been acquired and a considerable export trade fortified, the time has come to revert to open competition by tendering. There are clearly some advantages in now resorting to the normal competitive tendering practice. But, in my view, there were clearly prepondering advantages in our 'share-out' methods in the early stages, with our engineering consultants watching all the costs, stage by stage, and there is much to be said for continuity of employment among the workers in each of the workshops."

The basic principle on which the Board's formation was approved by Parliament is, of course, well known: namely, the uneconomic distribution of electricity in the Highlands should be, in effect, subsidised by the sale of energy from the large constructional schemes. That is not the whole extent of the encouragement which the Board has given to the Highland area however. For instance, stone cladding has been used in power stations, to revive the Scottish stone mason's craft. And on the industrial side, the encouragement of Scottish firms' participation in water turbine manufacture is another example, the arguments for which were clearly put by Mr. Johnston. The arguments both for and against open competition in a situation of this kind clearly have some force. Would the Board, for instance be justified in turning down an advantageous tender for a sluice gate installation if the gates were of a type made only by a Continental firm, which particularly suited the conditions involved? Should an alternative, more expensive type be selected, and if so from a Scottish manufacturer, or from an English one? The Board has clearly had many difficult obstacles to overcome in establishing a hydro-electric industry in Scotland, and its success bears witness to the soundness of its policy. But now that the industry is established and healthy, it would appear that the competition upon which other industries thrive should come more to the fore, as it evidently will in future purchases of water turbines.

SASUMUA DAM

The presentation of a paper by Dr. Terzaghi at the Institution of Civil Engineers would be expected to cause more than usual interest. The large number of members at the meeting on May 6 were not disappointed—except perhaps because the author himself was not present—for the subject discussed was, indeed, exceptional. Sasumua dam, which forms a reservoir for the water supply of Nairobi in Kenya, has been built largely of products of weathered volcanic rocks known as "Sasumua clay." This clay has unusual properties, which, it has now been established, are assets rather than liabilities from the civil

engineer's point of view. It was described, in the discussion, as being like an ordinary clay in all respects, except that the water content was about 25 per cent higher than would be expected. This led to a situation, as summed up in the discussion, where the normal soil mechanics tests gave all the information needed to design the dam " but you would not have known why it stood up." The explanation derives from mineralogical study of the clay. The extra amount of water is sequestered within the mineral structure—" micro-porous " was the term used by one speaker—in various ways (which were explained in detail by Mr. R. H. S. Robertson in his appendix to Dr. Terzaghi's paper) and so does not affect those physical properties of the clay which govern its structural strength.

The various designs proposed for the dam and the details of the rest of the scheme of which it is a part are explained fully in Dr. Terzaghi's paper and in the paper by Messrs. Dixon, Edington and Fitzgerald which was discussed at the previous week's meeting. Sasumua dam itself was the subject of controversy between the consulting engineers and contractors. The adequacy of the design and the methods of construction were challenged, and we heard at the meeting that the second design of the dam, which arose from the work of Professor Skempton and the late Dr. Guthlac Wilson, was considered " irresponsible " by the French engineers who were concerned with it, and who were supported by no less an authority than Monsieur Caquot. In the event, this design was generally endorsed by Dr. Terzaghi though, with an increasing knowledge of the materials and construction, he suggested some further economies and inferred conservatism rather than irresponsibility in the design. Now, with all the researches completed, it was suggested at the meeting that even further economies over Dr. Terzaghi's design could be made. But for the last word on these finer points we shall have to await the publication of the discussion and the author's reply. It seems a pity, however, that the French point of view was not stated at the meeting.

All this has been immensely interesting to civil engineers. The only people, presumably, who would express impatience would be those who were directly concerned with getting the scheme into operation as soon as possible. But the delays and frustrations now being over, the lessons learned can be assessed and, not least, there is some satisfaction in recording that the project was soundly conceived from the start, in spite of the novel situation. Clays of this general kind are apparently widely distributed in the tropics and so the Sasumua investigations will be of considerable general value. The consultants for Sasumua—Messrs. Howard Humphreys and Sons—have already encountered another project where the use of such a clay is envisaged for a dam. Several " by products " of the work are also worth noting. An improved stability analysis which permits appreciable economies in design was evolved at Imperial College as a consequence of the Sasumua investigations. Dr. Terzaghi, furthermore, records details of several dams which have been built of similar clay in various parts of the world, and comments on their behaviour. In his notes on the Silvan dam, a dam in this category which was built in Australia in 1926, he points out that the concept of optimum moisture content did not then exist. Nevertheless, the resident engineer Mr. A. E. Kelso " realised that the clay should be placed at the moisture content at which maximum compaction can be achieved and he developed a simple but adequate experimental procedure for determining the optimum moisture content, at least five years before the corresponding concept made its appearance in engineering literature."

PRESTRESSED CONCRETE

Articles on prestressed concrete are not so frequent in our columns now as they were eight or ten years ago. At that time, prestressed concrete was a novelty, and each new example of its use attracted attention ; now it is a standard method not generally the preserve of the specialist, but available to all qualified civil engineers. Its introduction and establishment in this position has thus been quite rapid. British progress can, however, be paralleled in most other countries, too, as is shown by the papers presented at the third congress of the Federation Internationale de la Precontrainte which has just been held in Berlin, from May 5 to 12. There is still a great deal of interest and of progress in this field of structural engineering ; over 1000 delegates attended the congress and three score or so papers were presented, under the three general headings of " Developments in Design Methods," " Progress in Site Techniques " and " Precast Prestressed Concrete Units and their Assembly." Thus the congress provides a very comprehensive commentary on recent developments both in practice and in theory. The special difficulties which are faced at the present stage of development have also been emphasised and evidently papers have been commissioned so that attention would be focused on these difficulties. On the theoretical side, the main problem of this kind is the treatment of shear force, and a theory to account for failure by shear under complex conditions is awaited. On the practical side, a problem which received similar attention was that of grouting ; improvement in the quality of grouting is an especially urgent requirement in post-tensioned structures. Generally, however, the tone of the conference papers appears to be one of confident progress.

The Engineer — 100 Years Ago (MAY 14, 1858)

" RAILWAY GUARD AND PASSENGER SIGNAL "

" This signal, the invention of Captain Norton, of Rosherville, near Gravesend, was described in a letter which appeared in THE ENGINEER some time since, as having been tried at the Tilbury Railway-station. It consists of a cylinder of wood having a hole drilled nearly through it. The upper part of the hole is stopped by a plug of wood or cork, and a steel pin or a common nail is inserted in it, having a small cap at its end, which, when the pin or nail is driven in, strikes upon an iron disc placed at the bottom of the hole, and so explodes the charge (of powder).

" The mode of using the signal is to let it slide down a tube attached to the side of the carriage, or placed through the bottom of it. The head of the nail striking the ground or rail, or, what is better, a flat piece of iron suspended a few inches below the tube down which the signal slides, an explosion takes place, which may be heard at a greater or less distance, according to the charge. In addition to the sharp report of the signal, there is a vivid flash and a cloud of smoke to enlist the eye as well as the ear of the guard and engine driver. For safety it is convenient to have the signal ready capped, with a cover over the percussion cap, which cover can be taken off in an instant when the signal is to be used. It is difficult to conceive what objection can be urged against the use of so simple a contrivance as this appears to be. Its cost is absolutely nothing, and, if properly constructed, would doubtless prevent many accidents."

INTERNATIONAL & UNIVERSAL EXHIBITION —BRUSSELS 1958

No. V—(*Continued from page* 686, *May* 9)

WORLD exhibitions are noteworthy for the encouragement which they give to new forms of architecture and structural engineering. Indeed, the emphasis given to these two subjects is sometimes held to be the only permanent benefit gained from them. We start this week a description of the more outstanding feats of structural engineering at the Brussels exhibition. Two relatively new forms of construction are prominent, namely, the anti-clastic shell roof, and very light steel roofs built from cables, and hence devised so that tensile forces predominate. The French building combines both these techniques, and here we illustrate its roof structure comprising a grid of cables with a secondary mesh between them. Surprisingly, an area about 240ft by 260ft is spanned by this very light roof.

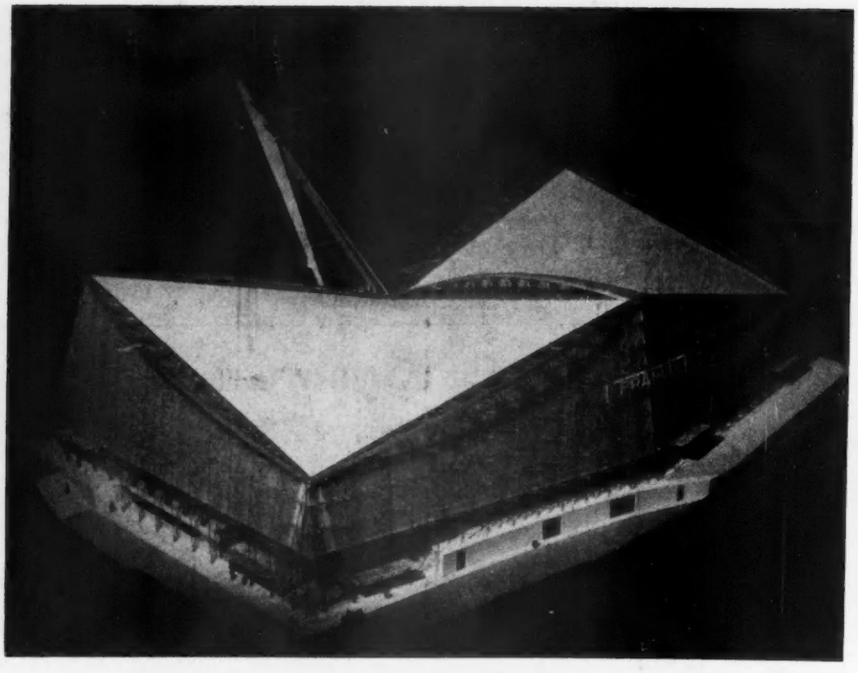
LOOKING back through our articles in this series, the reader will readily gain from the various illustrations of the exhibition grounds and buildings, a fair idea of the architectural atmosphere of the exhibition, and hence will have inferred that the structural design of some of the buildings is not without originality nor intricacy. We now intend to concentrate on this one aspect of the exhibition, and to dilate upon some of the more noteworthy structures at Brussels.

A large exhibition is traditionally expected to demonstrate all that is *avant-garde* amongst the architectural ideas of the day. And since such ideas must generally be based on appreciation of structural form or material, novelties of structural design, in the more restricted technical sense which we associate with structural engineering, are also expected. However, such novelty, although exemplified at Brussels by several striking designs, is not quite so extensive as might be expected in an exhibition of such importance. The reason, we think, lies in the relatively advanced state of the structural engineer's art. In most cases, and with most materials, the architect's requirements can be met without recourse to experiment ; whatever the architect wants, the structural engineer can achieve. Cost and not feasibility is normally the criterion of the structural design of buildings, but in an exhibition such as at Brussels, cost is less important, so a greater freedom results.

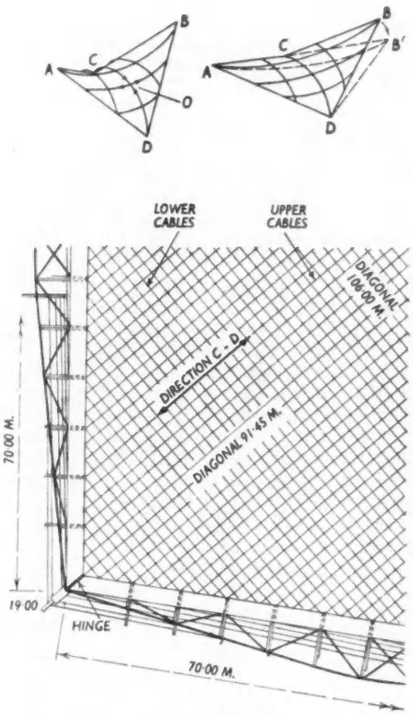
The whole exhibition is dominated by the Atomium, which, of course, is built in structural steel. It would appear that there have been no extraordinary subtleties in the structural design of the Atomium, massive and bizarre though it is. Having once decided upon the shape and scale needed, its translation into structural steel was clearly feasible. Another structural *tour-de-force* in the Belgian part of the exhibition is the big cantilever, balanced by a suspended hall, which forms part of the civil engineering exhibit ; it is built in prestressed concrete. But pride of place for originality in structural concept is clearly gained by the French pavilion. The principle of the doubly-curved shell roof has been adapted for construction in steel and two such shells have been built in such a manner that the building is carried principally at one support. How this is done is explained further on. The American building, which is circular and has no internal supports at all, is also very original. Other buildings of special interest on account of their structural design include the transport and telecommunications buildings in the Belgian section, and the Philips pavilion—a small structure which is part of the exhibit of the Netherlands. We also describe here the structure of the O.E.E.C. building—a light design in steel and plastics—and refer to the " folded slab " designs of the British buildings.

The doubly-curved shell known as the hyperbolic paraboloid is well exemplified at Brussels. Two striking examples are the French pavilion (in the ensuing description of which we describe the properties of such shells) and the Philips pavilion, but variants of the same basic idea are also to be seen, as well as other shell forms; for instance, the dome of the United Nations building. Judging from the exhibition, it would appear that an architectural vogue in the use of doubly-curved shells is imminent. Another somewhat novel structural technique which offers unusual lightness of construction, and which is equally in evidence, is the use of stretched steel cables in various ways, to support the roofs of buildings in place of a more conventional roof in structural steel. Because of the lightness and flexibility of designs of this kind, aerodynamic stability becomes a factor to be considered as well as static analysis.

Steel, concrete and timber are universally



The geometric form of the French pavilion can best be appreciated from this illustration of a model. The two anti-clastic shell roofs meet at a " spine " down the centre of the building



(Above) Diagrams illustrating prestressing of the roof. (Below) Details of cables and edge beams at the "low" corner of a shell

the structural materials of the exhibition. Plastics have found extensive use for roof coverings and cladding, but not as load-bearing structures, and the same is generally true of aluminium, which is to be found principally in a secondary role to steel, as mullions and glazing bars for instance. There appears to be only one major structural use of aluminium at the exhibition, and none of any less common structural material.

By contrast the use of structural steel is very widespread, and, indeed, almost always successful from an architectural standpoint. Large expanses of glass are characteristic of the various structural steel buildings, the steel itself forming a light framework which, by virtue of cantilevering, or by the subtle disposition of floor levels, is very unobtrusive visually. None of these buildings are illustrated here, but reference to our earlier articles and in particular Plates 6 and 7 of THE ENGINEER of April 25, will exemplify the success of such construction.

Prestressed concrete can be used in almost the same manner, as shown by one of the buildings in the Dutch exhibit. But concrete is generally to be found in a more spectacular role—the big cantilever, for example. There are one or two graceful bridges in prestressed concrete, too, and also pure "exhibition" structures, such as pylons.

It is difficult to pick out a single example of the use of timber, since there are several interesting designs in this material; the most extensive use is probably in several buildings in the section devoted to the Belgian Congo. One large building is built of portal frames of laminated timber which have an appreciable span. In another case, a light prefabricated steel truss system of framing has been used with timber.

THE FRENCH PAVILION

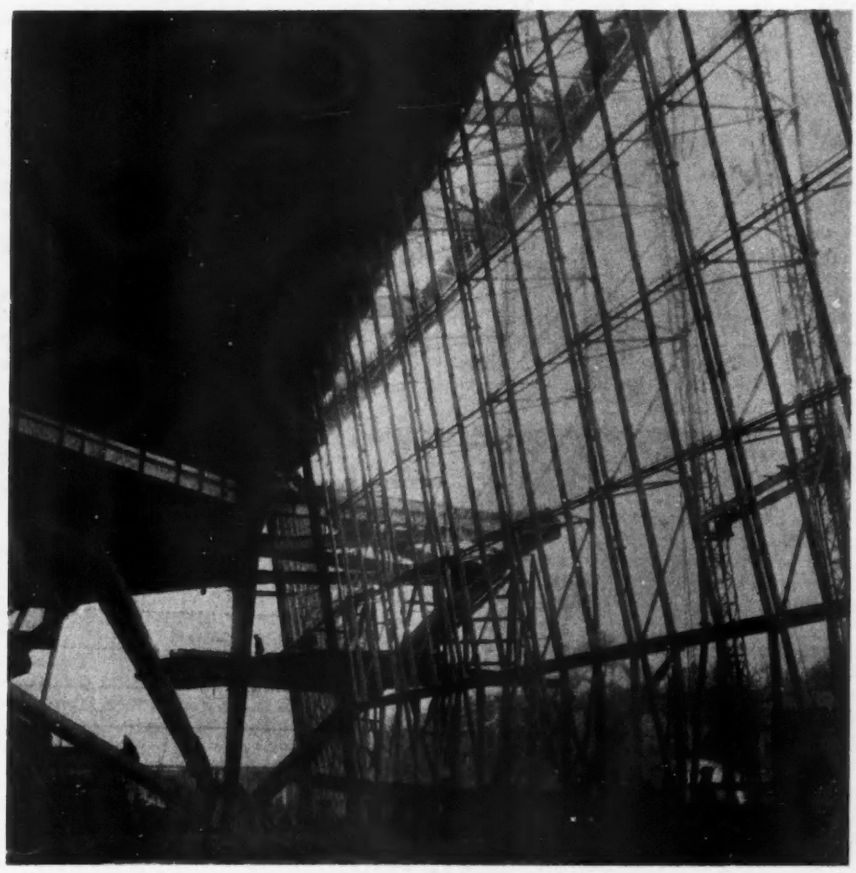
The aims which the designers of the French building sought to attain were ambitious; the building should itself be an outstanding feature of the exhibition, it was decided, and should, by virtue of the exceptional technical prowess of its design, demonstrate the scientific and architectural brilliance of France. It is a point of some interest that the fundamental approach to the French building is thus the antithesis of that of the British designers to their buildings (there will be a short note on the British buildings subsequently to illustrate this point). Having decided upon this general policy, the design of the French building then resolved itself into study of three problems, namely, enclosing a vast area, erecting a tall "flagmast" to carry the French flag and serve as a relay mast for television, and designing the exhibition floors within the building.

A short digression is needed here to explain the properties of the anti-clastic shell, which roofs the French building in the form termed the hyperbolic paraboloid. Such a shell roof transmits loads by direct stress—tension along the "sagging" direction of curvature and compression along the "arching" direction, and there are no bending stresses in the actual roof surface. It has the further advantage that the surface can be generated by straight lines parallel to the edges. The edges must be stiffened and the edge beams, which are normally in compression, carry the loads to the two low corners of the roof, where it is supported. There is a tendency for these two low corners to be pushed apart, so a tie may be needed between them, and there is also a tendency for the two high corners to rise, so anchor ties may be needed near the top corners. We described a roof of this kind—built for economy rather than for architectural effect—in our issue of July 26 last. This particular roof was in timber, and we pointed out that it challenged the supremacy of concrete for this class of construction.

Now, in the much larger French building at Brussels, we see the same principles applied to construction in yet another material, namely, steel, and in a novel manner such that the roof is built entirely of steel cables. It is in this way that the technical brilliance sought by its designers has been achieved. The theoretical difficulty which presents itself is that of the compressive forces in the shell which have to be changed into tensile forces by a prestressing process to enable cables to be used.

Consider the two small diagrams of the shell roof in the illustration above. On the left, at the point *O*, are shown the principal stresses characteristic of this type of roof—tension along the direction *AB* and compression along *CD*. In explaining how this is modified, the designers first consider it as a thin shell construction in reinforced concrete and point out that since the moduli of elasticity of steel and concrete are different, a small load will result in large increases in compression in the concrete, and, hence, in the risk of buckling. So, to avoid buckling under working loads, the dead weight of the concrete itself must be carried with virtually no compression due to its own weight. Thus, a pre-tension of the steel in the direction *AB* is needed—a complex operation requiring relative movement of steel and concrete, which must not be too great, so that tensile cracks in the concrete are not produced.

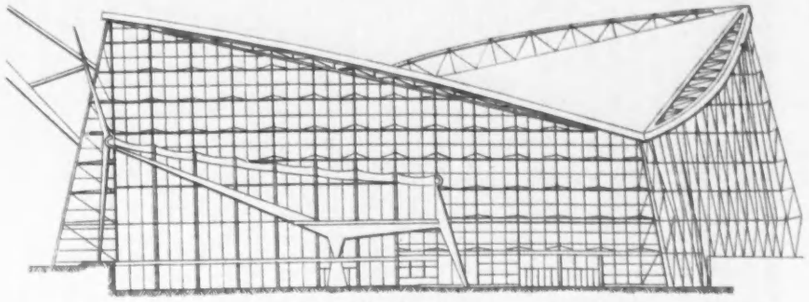
Suppose, now, there is no concrete in the roof at all when tension is applied in the direction *AB*. The cables will be tensioned only in so far as they are held down in the shell surface, so if a "skin" of cables in the direction *CD* is imagined with a similar "skin" immediately below it in the direction *AB*, tensioning of these lower cables will



A constructional view, showing steelwork at the principal support of the French building. Note the tubular steel mullions and the roof cables. The steelwork on the right of the support carries the 60m mast

THE FRENCH PAVILION AT THE BRUSSELS EXHIBITION

SECTION ON E.F.



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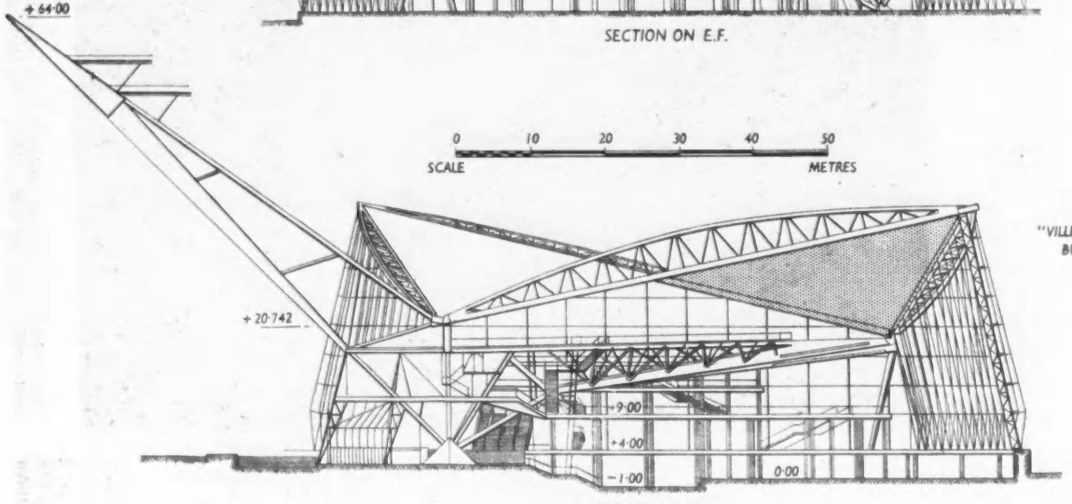

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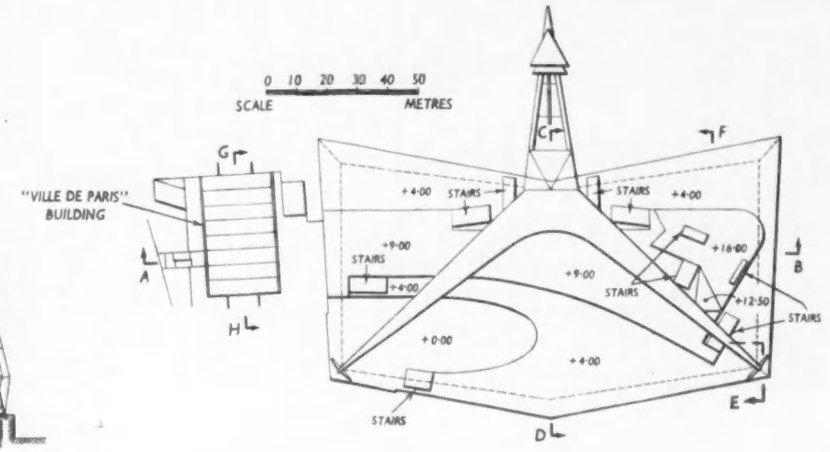
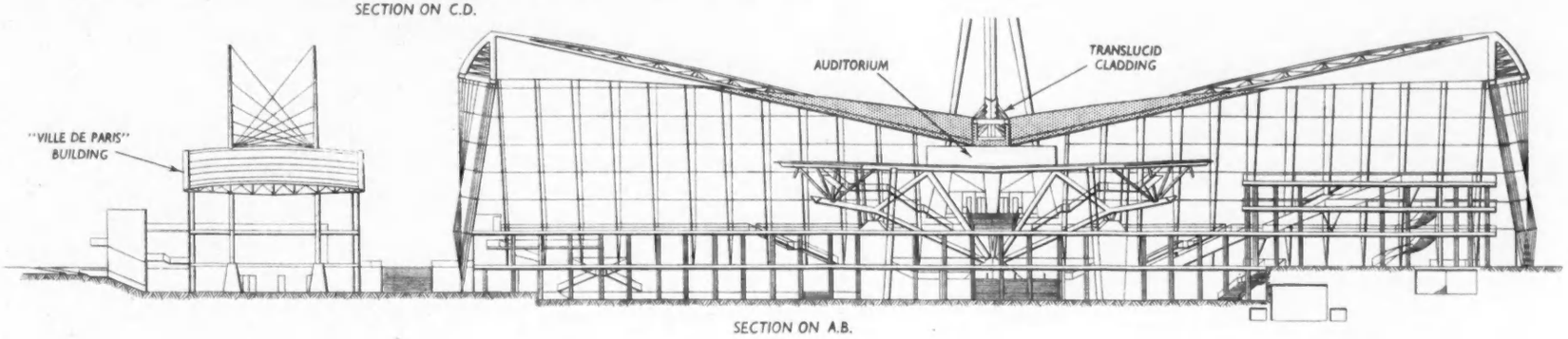




SECTION ON A.B.

induce tension in the upper cables running in the *CD* direction, and so a shell with principal stresses entirely in tension will be achieved.

The practical difficulty which had to be solved before such a construction could be considered for the French building was that of pre-tensioning all the cables in the *AB* direction simultaneously. Special studies of this problem were undertaken, and the way in which it was solved is strikingly simple. In the left-hand diagram, suppose the point *B* is erected slightly above its final position before the cables are placed. The two edge beams *CB* and *CD*, which, of course, are very rigid in relation to the rest of the structure, are hinged, about the axis *CD*, and then by lowering *B* to *B'*, as shown in the right-hand diagram, the whole network of cables is tensioned. The edge beams are heavy and by making use of their weight, pre-tension is induced simultaneously in all the cables ; these beams are, furthermore, stiff in the plane *BCD* but have little vertical inertia so their elasticity is utilised in the tensioning process and a ball-joint is not necessary at *C* or *D*. The magnitude of prestress induced in the cables was sufficient to ensure that under all conditions of load a residual tension was retained ; a positive load tends to slacken the upper cables, for example, and a negative load (caused by the wind) tends to slacken the lower ones.

The design of the French building incorporates several other points of interest apart from the adaptation of steel cables to form the shell roof in the way just described. The accompanying illustration showing a model of the building is particularly informative in giving a general idea of its shape and construction, and the drawing opposite gives further detail. It will be seen that there are two roofs—each a hyperbolic paraboloid—side by side and each shaped as a parallelogram with sides of 79m and 73m ; the area enclosed by the whole building is over 12,000 square metres.

About 80 per cent of the weight of the building (i.e. about 2000 tons) is carried at one support. It will be recalled that two points of support are needed for each shell. A common point, serving both shells, is at the centre of the façade of the building. From this point, structural steel cantilevers, serving also as ties for the shells, extend diagonally through the building, and most of the dead load of the two outer points of support is carried back through these cantilevers to the one central point (but apparently subsidiary supports have been placed under each cantilever as well, as shown in the drawing, at the point where the lower chord of the cantilever changes its slope). The V-shaped cantilever structure thus formed is balanced statically by the enormous flagmast structure which cantilevers outside the façade and is 60m high. The drawings clearly show this configuration, and a constructional view of this major point of support is also illustrated. Above it, the steelwork forms a hollow construction enclosing an auditorium seating 300 people. An architectural feature is made of this supporting point. As the visitor enters the building, he is faced by a concrete pedestal, prominently placed in the entrance hall, upon which the mild steel bearing pad, which carries the steelwork above, is supported.

There are also bipod supports at the extremities of each of the two cantilever/tie structures inside the building, which have been added largely to give horizontal restraint against wind loads. The mullion-like members all round the building, which are of tubular steel, act as struts or ties according to whether the weight of the edge beams at the particular point concerned was greater or less than the weight needed to induce prestress in the roof cables.

Other principal dimensions are given in the drawings, which also show the elaborate floor layout, and the subsidiary building called "Ville de Paris." The floors were designed for a live load of 500 kg per square metre, and have the minimum number of supports, their structure being largely separate from the main structure just described. The floor structure is in steel, with precast concrete slabs, all designed for rapid erection and dismantling ; 25,000 square metres of exhibition space is given by five floors.

The walls are of glass or translucid corrugated plastics, and the roof is covered with a plastics material. The constructional illustrations give an idea of the steelwork and cable details. Ground conditions at the Brussels site have led to the reduction of ground supports to a minimum on several of the buildings, and this was the reason for the virtually single support of the French building. Generally, it will be appreciated, economy in materials has been obtained by virtue of the lightness of the structure. It is unfortunate that the building was not completed on time, and so we cannot give an impression or illustration of the final architectural effect or that which the interior of the building will give. Even so, it has already been the butt of some criticism, and has been described by Mr. J. M. Richards as "a great sagging rectangle of a building ..... simply a contraption."

The architect responsible for the French pavilion is Monsieur G. Gillet, and the consulting engineers are Messrs. R. Sarger and J. Prouve. The main contractor is Anciens Etablissements Eiffel of Paris.

(*To be continued*)

Metallurgical Aspects of Nuclear Power Engineering

By J. C. WRIGHT, Ph.D., B.Sc. (Eng.), A.I.M., A.M.Inst.F., A.C.T., Birm. *

No. IV—(*Concluded from page 689, May 9*)

The basic metallurgy associated with nuclear power reactors is described in this article, both for the British emphasis on gas-cooled reactors and the American trend towards liquid cooled reactors. The physical metallurgy of the fissile fuel metals, uranium, plutonium and thorium is described in sufficient detail for the interesting behaviour of these materials under reactor conditions, particularly irradiation and corrosion, to be appreciated. Possible explanations of the mechanisms of these unusual effects are reviewed. Methods of developing fuel elements, with a view to minimising difficulties experienced in reactor operation, are then briefly reviewed. This field covers the use of alloys of the fissile metals, present and possible future methods of canning fuel elements and the increasing interest in ceramic and cermet fuels. Development of certain non-fissile metals and alloys for use in reactor construction has been rapid. These developments are outlined and the effects of irradiation and dry, wet and liquid-metal corrosion, on the properties of non-fissile materials are discussed. The applications of physical metallurgy to reactor development are emphasised but, where appropriate, the production techniques for some of the special materials are introduced.

The Effects of Nuclear Reactor Conditions on Non-Fissile Metals and Alloys

BROADLY speaking, the abnormal conditions imposed on metals and alloys under nuclear reactor conditions are the effects of irradiation and, in some parts, unusual corrosion effects.

Irradiation Damage

Much of what has been said earlier about the radiation damage of fissile materials applies to non-fissile materials also. In general, radiation damage will be caused by neutrons rather than fission fragments in non-fissile metals, because of the longer mean free path of neutrons. Fission fragments, having a short mean free path, are more likely to be responsible for damage near where the fragments are created ; in fact, within the fuel element itself. The general level of irradiation damage in non-fissile materials is considerably less than in fissile materials, but nevertheless the effects are important, particularly from a long-term point of view.

The damage to non-fissile materials under neutron irradiation is associated with fast neutrons knocking atoms out of their normal lattice positions to leave a vacancy. These primary knock-ons then collide with other atoms, producing secondary knock-ons which finish in an interstitial position and release considerable energy as heat. The release of energy may allow dislocations to overcome obstacles, move and regroup themselves, thus allowing local or extended deformation. The point defects themselves may be absorbed preferentially on dislocations of a certain vector type or on certain parts of grain boundaries, so changing the grain shape in a preferred way. The temperature effects may result in a redistribution of alloying elements and impurities or result in phase changes at temperatures not normal for the particular phase changes under irradiation-free conditions. The thermal spikes will lead to local temperature gradients and internal straining. Slow neutrons may be responsible for transmutation effects by neutron capture and radioactive decay, thus radically altering the impurity level of the original material.

The various manifestations of these internal alterations must be well studied before long-term reliance can be placed on much of the structural engineering data for reactor construction. Some of the phenomena already investigated will be described.

Creep Characteristics

Most determinations of creep strength characteristics have shown little effect of irradiation. Experiments have shown either no change or a slight decrease in creep strength after irradiation. However, the

* Dept. of Metallurgy, College of Technology, Birmingham.

long-term creep resistance of high temperature alloys working near their upper limits of creep conditions have yet to be fully determined under strong irradiation. Since several such alloys depend, for their continued creep resistance, on the stability of fine precipitates then, knowing that thermal spikes can alter radically the characteristics of such precipitates, it is natural to suppose that long-term effects of creep strength deterioration may arise.

Hardening

Most metals become hardened by irradiation and the hardening may persist after the metal has been heated to temperatures at which most of the irradiation damage, as shown by other properties, has been annealed out. Radiation effects reach a saturation limit for hardness, but generally at a level below that accomplished by age or work hardening. In general, radiation effects are least pronounced in close-packed atomic lattice structures, and in metals possessing a low degree of anisotropy. The magnitude of the changes in properties depends in part upon the initial structural condition of the material. The percentage change is greater for materials in the soft or fully annealed condition compared with the cold worked or age-hardened condition. Many of the properties of metals which are changed by irradiation can be restored by annealing and it is not surprising, therefore, that materials irradiated at elevated temperatures exhibit less damage than when irradiated at normal or sub-normal temperatures. Irreversible damage, such as accumulation of fission products in fuel metals, creation of new elements, physical cracking or dimensional changes are not affected by annealing.

Stress/Strain Relationship

The general effect in soft metals is that irradiation raises the elastic limit considerably and reduces the rate of strain hardening. The yield stress in copper single crystals at room temperature is raised from almost nil to an appreciable figure by irradiation, the initial rate of work hardening being decreased. The yield stress of nickel at 20 deg. Cent. increases by 50 per cent after irradiation and the ductility decreases. On the other hand no change is observed in lead crystals probably because of the low annealing temperature of lead.

In the plastic range of an irradiated metal in a load/extension test, the slip lines formed are clearly visible, being clustered into well-defined, coarse, straight bands joined by prominent cross-slips.

An example of stress/strain curves for

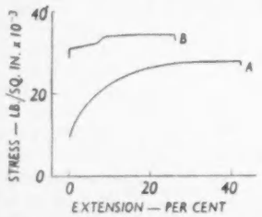


Fig. 11—Stress/strain curves for copper at room temperature: *A*, before; *B*, after 5×10^{19} n.v.t. irradiation

polycrystalline copper at room temperature is shown in Fig. 11. A yield point has been introduced by the irradiation and the elongation to fracture reduced. The effect of previous cold work on the irradiation hardening of copper is illustrated in Fig. 12. Previous tensile deformation diminished the increase in yield stress upon subsequent irradiation. Both examples are taken from work by Makin.[21]

Embrittlement

Neutron irradiation may increase the tendency of a metal to fail with a brittle fracture. Such loss of ductility can be serious, particularly, for instance, in the design of reactor pressure vessels. The

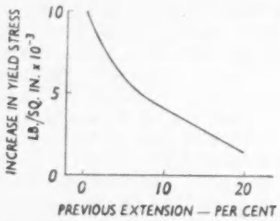


Fig. 12—Effect of previous cold work on increase in yield stress of copper after 5×10^{19} n.v.t. irradiation

embrittlement effect is most easily studied by measuring the effect of irradiation on the transition temperature of the metal, above which it will be ductile and below, brittle. In general, the effect of irradiation is to raise the transition temperature, thus giving a specimen a greater chance to fail by brittle fracture at room temperature, say. As an example of the embrittlement effect on a normalised ferritic steel, the curves shown in Fig. 13 follow the results of work by Wilson and Billington.[22]

The influence of irradiation is markedly affected by temperature of irradiation and embrittlement effects are less at high temperatures. This is again supported by the fact

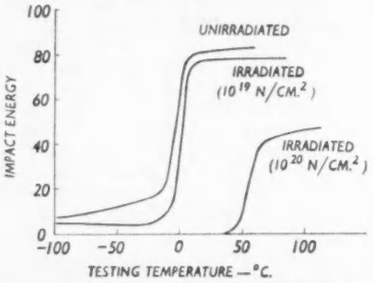


Fig. 13—Effect of irradiation on the impact resistance of a normalised ferritic steel

that it is possible to reduce the tendency to brittle fracture, after irradiation, by annealing. The fact that components of a reactor subjected to neutron irradiation will also tend to be at least above room temperature if not much at higher temperatures gives a margin of safety against brittle failure. The trend towards even higher temperatures in reactor working will extend the safety margin. As a further safeguard, it is usual to use steels which normally have a low transition temperature, so that when the transition temperature is raised by irradiation it will still be below the working temperature of the steel.

Materials other than steel can be embrittled by irradiation. Bruch, McHugh and Hockenbury[23] observed that a neutron irradiation between 1·9 and $5{\cdot}9 \times 10^{20}$ n.v.t. raised the ductile-brittle transition temperature from −30 deg. Cent. to +70 deg. Cent. and hence the material was completely brittle at room temperature. Although not dealt with in this section, uranium also becomes embrittled by irradiation.

Transmutation Effects

Transmutation effects may occur when atoms capture neutrons, usually slow neutrons, in almost any part of the reactor, to give new atoms of different elements after radioactive decay. Fortunately, in most metallurgical applications, the build up of impurities is so slow that not much difference is noticed compared with the impurity content of the original material. If impurities generated in this way are appreciable their effects will be noticed in super-purity materials, and in any material, the most important effects will be noticed when the new element is insoluble in the parent lattice. Embrittlement may then occur, particularly if the impurity has a tendency to segregate to grain boundaries.

In the same way as in fissile metals, some gases may form in structural materials and because they are more likely to aggregate and form gas pockets rather than diffuse to an absolutely free surface, the metal swells. As an example, helium is often formed during irradiation of light elements with neutrons. If the strength of the matrix is increased or its temperature decreased it may be possible to contain the gases under greater pressure and reduce swelling, but of course there is a limit to how low the temperature of the material can be kept. Again, hard materials will crack without distortion if the gas pressures involved are high enough.

One aspect of transmutation effects may have an especially significant importance. If an alloy is dependent on a particular element for its properties and that element has a high neutron capture cross section it may become significantly depleted due to transmutation effects. The properties of the alloy would presumably alter during the period of irradiation due to the loss of the particular alloying element. This is likely to be a very long-term effect.

Miscellaneous Effects

The damping capacity of a metal is reduced after irradiation because the material becomes more elastic. Electrical resistivity increases on irradiation because of the disorder of an irradiated lattice which is capable of scattering electron waves. On annealing, normal resistivity returns. The normal order-disorder transformations in alloys exhibiting extended super-lattice formation are upset by irradiation. For instance, the ordered structure in the copper-gold alloy system at 25 and 50 per cent gold in copper should be disrupted at room temperature to give a disordered structure.

Alloys depending on age-hardening properties can be markedly affected by irradiation. Normally, such alloys are solution-treated and quenched, followed by ageing naturally at room temperature or artificially at a somewhat higher temperature. In effect, solution treatment allows the matrix to absorb in solid solution a maximum amount of would-be precipitate. On quenching, the precipitate is held in super-saturated solution. Ageing allows the super-saturated solid solution to approach equilibrium by tending to precipitate the second phase in a very fine form. In some alloys, the would-be precipitate does not break its coherency with the parent lattice, but under controlled conditions coherent and non-coherent precipitates promote useful strengthening and hardening. By holding the super-saturated solution at sub-zero temperatures the ageing effect can be held back for very long periods and even indefinitely. Neutron irradiation will promote ageing under such low temperature conditions. At normal ageing temperatures irradiation should accelerate ageing, and of more importance to its applications, an aged component may well become over-aged during service at temperatures when it would

normally be stable. In general, its properties would then deteriorate. The accelerating effect of irradiation is presumably due to localised dissipation of energy, after neutron collisions, being equivalent to a general rise in temperature.

Damage to Control Rods

Control rods are inserted into a reactor to cut down activity when required, by absorbing excess neutrons over those required to keep the chain reaction going. They also act as a safety device to shut down the reactor when necessary. Control rods are therefore made from high neutron-capture-cross-section materials. The control material inevitably is prone to damage by neutron irradiation, particularly over its surface. The fact that the surface absorbs neutrons readily implies that the interior will be less affected by neutrons because only a few will get very far past the surface layer. Since the surface is vulnerable, control material should be canned to avoid premature disruption. The failure of control rods can be due to one or more of several causes; vacancy/interstitial production, helium gas bursting, surface disintegration and spalling, or gradual depletion of strength generally. To take some of the damage concentration off the surface it is possible to disperse the control material in a matrix which itself resists damage. Boron carbide is a possible material for this application. Pure boron can be used as a control material, but at higher temperatures of reactor operation helium gas swelling occurs. In the G.E.C.–Simon-Carves design of reactor for South of Scotland Electricity Board, the controls consist of 156 rods, 2in in diameter by 19ft long, stainless steel tubes with boron containing inserts.

Cadmium is less critical than boron in that it does not form helium gas, but is less suitable for high temperature applications in another respect because of its high vapour pressure and low boiling point. Other possible control materials are hafnium, samarium, europium and silver, but they are very expensive. Hafnium is particularly attractive, but it is extremely expensive even though it is a by-product in the production of reactor grade zirconium.

Corrosion Aspects

Corrosion in a reactor is an important and sometimes complex subject. Each design of reactor has to be treated separately where details of corrosion are concerned. For this reason it is only possible, in this article, to deal with some of general aspects of reactor corrosion.

It has already been pointed out that uranium itself has a rather poor corrosion resistance and among other reasons for development, canning materials provide a large degree of corrosion resistance in their respective surroundings. Both Magnox and Zircalloy canning materials have well-developed corrosion resistance properties. Zircalloy is based on zirconium which is very sensitive to the influence of nitrogen on its corrosion resistance. The alloying elements, 1·5 per cent tin, 0·07–0·20 per cent iron, 0·03–0·08 per cent nickel and 0·05–0·15 per cent chromium are controlled and the upper limits for nitrogen and carbon are 100 and 400 p.p.m., respectively. The tin forms a compound with the nitrogen preferentially and prevents it from impairing the corrosion resistance. Similar trace element contents influence the behaviour of the Magnox alloy, which is magnesium base, plus traces of beryllium and calcium. The rate of corrosion of a metal depends on the rate at which the metal ions can diffuse out, and the corrodant ions can diffuse in, through the corrosion product film. This rate of diffusion depends, among other factors, on the energy required for an ion to squeeze through the field of the appropriate lattice. If, now, the metal being corroded is alloyed with an element which will go into solid solution but whose ions are slightly smaller than the parent lattice ions, the resultant corrosion product film should have a contracted lattice compared with the parent lattice. This is so because the alloying ion, being small, will tend to diffuse easiest to the surface and so the corrosion product film will be enriched in alloying element compared with the material being corroded. Because the alloying element ions are small, the corrosion product lattice will be contracted. The energy required of a parent metal ion or corrodant ion to squeeze through the corrosion product lattice is therefore increased and corrosion slows down. Thus the formation of magnesium oxide on Magnox is limited. The beryllium ions, being smaller than magnesium, will diffuse to the outer surface more quickly and concentrate in the outer parts of the film. The film lattice will become compacted and make it very much more difficult for fresh magnesium ions to diffuse through it.

Coolant Gas Problems

For a large proportion of reactors under development at present, high purity CO_2 gas is specified as the coolant. Although the CO_2, when admitted initially to the reactor, is very pure, its composition in operation may alter due to a variety of reactions. In contact with graphite or various metals such as iron or magnesium, the CO_2 might be reduced to some extent to CO. Moisture in the gas may lead to the water gas type of reaction and hydrogen would be released and again hydrogen might result from the action of moisture on reactor metals. Several of these reactions cause corrosion themselves, but the modification of the coolant may lead to subsidiary corrosion.

In all corrosion problems in a reactor, the influence of irradiation has to be considered. Oxide films on metals are ionic in character and are sometimes sensitive to radiation, and additionally there is the possibility of abnormal phase changes and of transmutation effects changing the chemistry of the reaction. Hittman and Kuhl[24] have shown aluminium to be attacked less in the presence of irradiation, but copper and mild steel much more. They concluded that where corrosion resistance depends on the formation of a protective oxide film, the irradiation tends to act like an active oxidising agent and so tends to inhibit corrosion, but where there is no protective oxide film, radiation increases the corrosion rate.

Liquid Metal Corrosion

The principal liquid metals concerned in possible designs for nuclear reactors are mercury, sodium, sodium/potassium, lead, bismuth and lead-bismuth eutectic.

Corrosion tests have been carried out on systems made up from one or more of the above metals and materials likely to be used in the parts of the reactor where the coolant or liquid fuel is circulating.

Rather less work has been done with mercury as a corrodant in a reactor than on some of the other liquid metal systems, but it has been pointed out that in choosing steels for containing mercury under reactor conditions, nickel steels should apparently be avoided.[25] Nickel is much more soluble in mercury than is pure iron and the nickel appears to be selectively dissolved out of alloys containing nickel; 18/8 stainless steel for example. Since a degree of high temperature strength and oxidation resistance are required of most steel reactor components, low alloy chromium, molybdenum, silicon steels have found favour in some cases. There are processes for inhibiting mercury attack on nickel-free steels which allow for 1–10 p.p.m. of titanium to be added to the mercury. Possibly a protective film of iron-titanium compound is formed on the steel. Zirconium has a similar effect.

Metals corroded by sodium or sodium/potassium alloy may either gain or lose weight. A weight loss is usually associated with solution of the metal itself or of some minor constituent of the material in the liquid sodium. A weight gain can usually be traced to a reaction in the system. These reactions are most often due to small amounts of alkali metal oxides in the molten alkali metals. Oxygen contents of the order of 0·001–0·01 per cent are extremely important in this respect. Under such conditions, stainless steel gains weight due to the formation of a chromic oxide scale. The liquid coolant containing oxygen can decarburise a low-carbon steel and then proceeds to dissolve the iron very slowly. However, if the oxygen content of the sodium is kept sufficiently low by the use of getters and avoidance of oxygen sources such as scaling of components prior to assembly, the corrosion rates can be reduced a great deal. High purity uranium is attacked by the oxygen impurity in liquid sodium at temperatures up to 600 deg. Cent. Uranium dioxide grows on the surface of the uranium, the rate of growth being dependent on the amount of oxygen in the sodium. Calcium added to the sodium acts as a corrosion inhibiting agent and the corrosion of uranium in sodium does not seem to be of a serious nature at temperatures around 500 deg. Cent. provided the sodium is kept free from oxygen.[26] Zirconium and stainless steel are not corroded by sodium if impurities in the liquid can be adequately maintained at low levels. This can be accomplished by cold-trapping or gettering. The principal impurities dangerous to zirconium are oxygen and hydrogen. The solubilities of these are low at temperatures just above the melting point of sodium and they therefore tend to be eliminated in the cold trap. Gettering with calcium or possibly a 50 atomic per cent Zr/Ti alloy greatly assists in controlling the oxygen content of sodium. A "getter" must be capable of reducing the oxide of the metal it is intended to protect, in this case zirconium. Although the getter may itself be soluble in the coolant, the resulting oxide should preferably be insoluble so that it can be filtered out as it forms.[27]

The metals lead and bismuth have been considered for use in the molten state in reactors. The metals are capable of causing intergranular attack on components, possibly due to solution of grain boundary impurities. It is suspected that oxygen contents of the metals may be important in this process, but the exact role which lead and bismuth oxides play is still obscure.[25] Russian work[28] has shown a different aspect of the corrosion by lead/bismuth eutectic. They suggest that damage to an 18/10 Cr/Ni stainless steel by Pb/Bi eutectic at 500 deg.–600 deg. Cent. proceeds largely by "leaching" of nickel from the steel. Nickel, calcium or barium added to the eutectic inhibit the corrosion. It is easier to add nickel and 0·6 per cent in the eutectic acts as an effective inhibitor.

Mass Transfer Corrosion Effects

The problem of mass transfer has been briefly mentioned in the section dealing with

liquid fuels. In a reactor with a liquid metal coolant, temperature differences in the coolant circuit are inevitable and if there is any liquid solubility of the constructional materials, they will dissolve to the greatest extent at the high temperature part of the circuit and, if the solubility limit is exceeded, they will precipitate in the cooler part of the circuit. The coolant is thus unsaturated when it returns to the high temperature zone and the process continues.

Another difficulty met with in the above type of mass transfer is the influence of impurities. It has been shown that the mass transfer between ferrous constructional materials and a sodium coolant circuit is accelerated if the oxygen content of the sodium exceeds 30 p.p.m. by weight. With very pure sodium, mass transfer between components and coolant is practically eliminated. Horsley[29] suggests that at temperatures over 300 deg. Cent. the oxygen enables a mixed oxide to be formed, $2Na_2O$ FeO, and that this is unstable at lower temperatures, releasing the oxygen for further attack.

Mass transfer due to solubility changes can be avoided by encouraging stable compound formation. In the case of uranium/bismuth liquid fuel, a zirconium addition inhibits mass transfer by the formation of zirconium nitride on the surface of the steel structural components. The steel usually provides a sufficient source of nitrogen.[30]

Conclusion

Most of the major metallurgical aspects of nuclear reactor technology have been outlined in this series. There are other aspects and indeed the aspects already dealt with have not been exhaustively treated. This is conditioned by the fact that development of the metallurgical side of the nuclear power programme is by no means exhausted and a vast amount of work has still to be carried out. On several theoretical aspects a number of theories have been put forward to explain a given mechanism. The theories do not conflict necessarily but obviously differ in detail and until crucial experiments are designed to settle the shades of argument it will be difficult to set off the widely observed practical details against their theoretical background. This situation should improve rapidly and allow the use of more advanced reactor designs consequent on the development of satisfactory metallurgical techniques and materials.

References

[31] M. J. Makin, *Bull. Inst. Metals*, 1955–56, 3, 101.
[32] J. C. Wilson and D. S. Billington, Nuclear Eng. and Sci. Congr., Cleveland, 1955, Preprint No. 89.
[33] C. A. Bruch, W. E. McHugh and R. W. Hockenbury, *Trans. Amer. Inst. Min. Met. Eng.*, 1955, 203, 251.
[34] F. Hittman and O. A. Kuhl, U.K.A.E.R.E., 1955, Report, BNL–2257.
[35] L. F. Epstein, Internat. Conf. Peaceful Uses of Atomic Energy, 1955, Paper 119.
[36] H. Mogard, Ibid., Paper 787.
[37] S. Siegel *et al*, Ibid., Paper 829.
[38] L. I. Tsuprun and M. I. Tarytina, Ibid., Paper 638.
[39] G. W. Hosley, *Journal Iron and Steel Inst.*, 1956, 182, (I), 43.
[40] D. H. Gurinsky, Internat. Conf. Peaceful Uses of Atomic Energy, 1955, Paper 118.

Electrical Research Association

THE annual report of the Electrical Research Association for the year 1957 is of more than usual interest because it records the first full year of work in the new E.R.A. laboratories at Cleeve Road, Leatherhead, which were formally opened by the Minister of Power, Lord Mills, on June 26 last.

A typical example of the class of research project which yields useful results by the accumulation and sifting of vast quantities of experimental observations over long periods, is the collection of data on switching surges on overhead lines. An E.R.A. report on this work is to be presented next month at the meeting in Paris of the Conférence Internationale des Grands Réseaux Electriques (C.I.G.R.E.). This report will describe results obtained with an automatic three-phase cathode-ray oscillograph which was installed at three 132kV sites on the British grid system and operated there for an aggregate working time of two years. It will be the most comprehensive account yet published of automatic recording of switching surges, made under normal working conditions.

One piece of research that has led to a reduction in the margin of design error is the study of the cooling of transformer substations by natural ventilation. This work is now nearing completion and the results to be published should remove much of the guesswork from the problem of deciding the size and disposition of ventilating ducts.

An important development in insulation is that proof has been given of the importance of moisture content in controlling the discharge level of cellulose. The breakdown strength of one of the new high-density polythenes has been found to be in accord with the electro-mechanical theory of breakdown recently propounded by the E.R.A. An example of the unexpected issues that sometimes emerge from fundamental research is to be seen in the Association's work on organic compounds containing hydrogen bonds: this work has produced, indirectly, a possible theory to account for the electrical properties of nerve membranes.

A problem of more immediate practical importance is that of segregating faulty capacitors in a production batch, a matter of growing significance to-day when large numbers of such components are used in automatic control systems, submarine repeaters and computers. To help designers, the E.R.A. is doing experiments with a simple automatic system whereby brief over-voltages are applied to small capacitors in the hope that such treatment will break down the inferior ones without damaging the good ones, and will thus increase the uniformity of life of those that survive the test.

In the field of flameproofing, acetylene and ethylene have been included in E.R.A. researches on the limiting safe currents in intrinsically safe circuits used for measurement and control in atmospheres of explosive gas. Ethylene is included in a British Standard issued during the year and, accordingly, it is now possible, for the first time, to have a certificate for equipment to be used in an atmosphere of ethylene. Although etched well-glasses reduce glare, they have not hitherto been acceptable for lighting fittings because of their supposed liability to fracture under thermal shock or impact, but tests made by E.R.A. show that this ban is unjustifiable.

An unusual opportunity to measure the strength of tower foundations presented itself when the South Eastern Electricity Board decided to discontinue using a 33kV overhead line in the Byfleet-Woking area. Several modes of loading were applied to the towers and a report is being prepared. Briefly, the tests showed that the foundations were much weaker than the towers, though both had been designed for the same loading conditions. Substantial economies should therefore be possible and the results may be applicable to railway electrification.

In collaboration with the then Central Electricity Authority and other bodies, the E.R.A. completed a series of tests in 1957, at Cliff Quay power station—the first full-scale experiments on system stability to be made in Great Britain. The broad conclusions to be drawn from this work were that the actual behaviour of the system under transient conditions was generally in harmony with the predicted behaviour. Such knowledge is very useful in parts of a system where the conditions are marginal, and the work at Cliff Quay should stimulate further studies, making use of the E.R.A. network analyser which is available to members of the Association and others.

Research sponsored by the E.R.A. at Imperial College has been continued on the properties of steam at a temperature of 750 deg. Cent. and high pressures. With the help of an electronic computer to evaluate results, a preliminary survey of about ninety runs has been made, up to 3000 lb per square inch and 750 deg. Cent. It is hoped to determine the properties up to 5000 lb per square inch and 750 deg. Cent. in time for the meeting of the International Commission on the properties of steam, to be held later this year.

A new sub-committee has been formed to study the properties of titanium alloys for use in large turbo-alternators: the fact that titanium is non-magnetic and has a high strength-to-weight ratio makes it very attractive as a material for the end-bells of rotors. Accordingly, an end-bell of titanium alloy has been forged to serve as a test piece for industrial research laboratories.

Work done at B.I.S.R.A. on the effect of impurities on the magnetic properties of silicon-iron transformer sheet shows that the losses could be reduced by 10 to 15 per cent by reducing the nitrogen content from about 0·006 to 0·003 per cent by weight. With commercially pure alloy the improvement, though significant, is less marked. Further work on the influence of nitrogen and other impurities is in hand. In work done at the N.P.L. and sponsored by the E.R.A. anisotropic magnetic alloys for permanent magnets have been shown to be very stable when subjected to temperature rises up to 200 deg. Cent. and to be greatly superior to the older materials.

At the Shinfield research station the Eversley multi-purpose crop drier has been in constant use for nearly a year and has produced about 50 tons of hay. Although baling has increased the drying time, it has doubled the size of batches and has reduced the average cost of electricity to 17s. 5d. per ton dried.

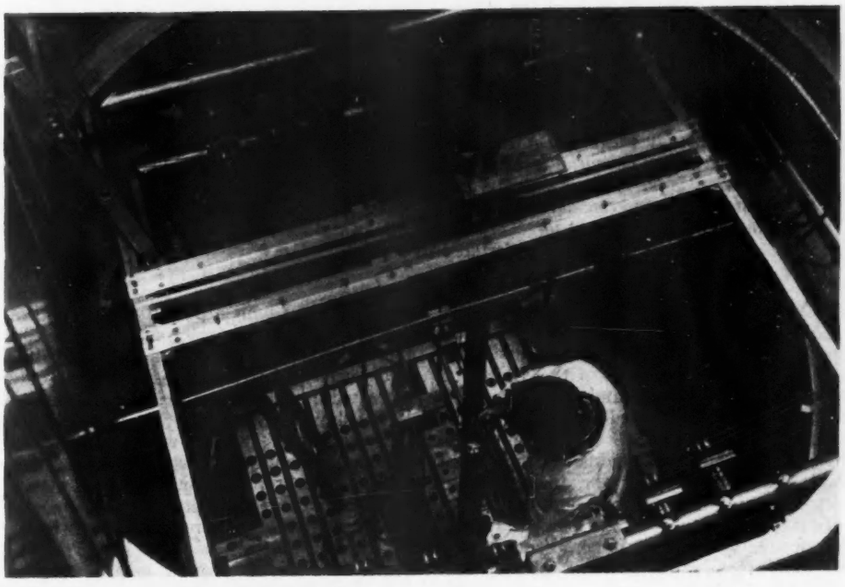
Satisfactory results have been obtained in horticultural experiments on the supplementary irradiation of tomato seedlings, and lettuces irradiated by light have been grown successfully in a glasshouse for the first time. In a new growth-room first experiments have been made with the raising of plants grown entirely in artificial light. Strawberries grown in frames and cloches have responded well to soil warming and to artificial increases in day length by irradiation. Accelerated growth has allowed harvesting to be completed thirteen days earlier for certain varieties of strawberries and extended day length has advanced harvesting by ten days. Further improvement does not, however, appear to be possible by combining the two processes.

Unclassified researches by the E.R.A. include work done in collaboration with the British Welding Research Association: investigations on the self-adjusting welding arc and on the arc and bead characteristics have been extended to include the effects of changing the arc voltage. These studies suggest that the generally accepted practice of specifying welding conditions in terms of current and voltage may be inadequate. Visual examination of the welding arc with the help of high-speed photography has led to better understanding of the mechanism of material transfer and allied phenomena. A colour film showing material transfer in the self-adjusting arc is available on loan to members. Further researches on the electrical characteristics of the tungsten arc have been started; some of this work has a special bearing on the suppression of radio interference from industrial equipment.

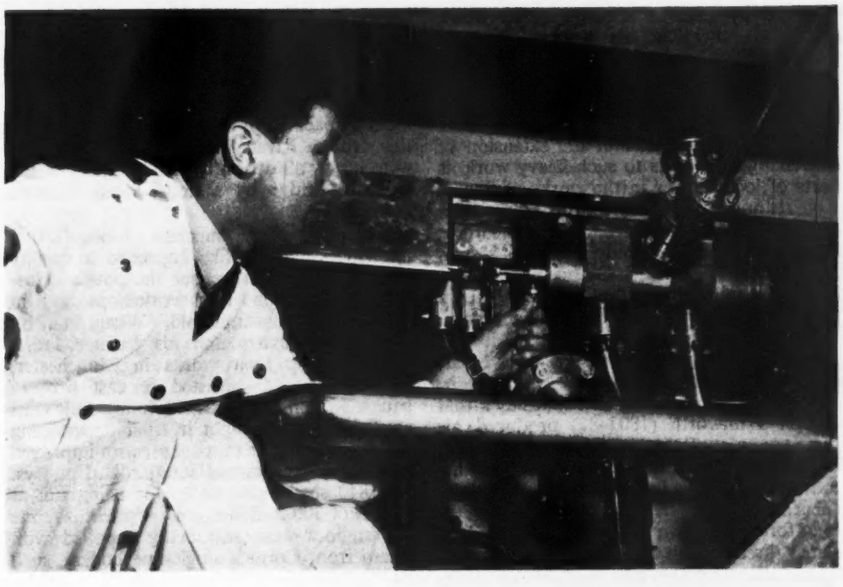
In investigations at King's College, London, into parasitic losses in alternators, experiments on tooth losses have confirmed theoretical predictions made earlier. A homopolar machine has been built to enable flux penetration and tooth-ripple losses to be measured with greater accuracy.

In the course of work on joints between aluminium conductors preliminary tests have been done to study the effect of pressure on the contact resistance of elementary busbar contacts with surfaces prepared in various ways. Some jointing compounds have been found to be effective in reducing contact resistance.

Neptune Experimental Reactor



As described in " The Engineer " for November 15, 1957, page 697, " Neptune " is a low flux, zero energy reactor (developing only 60W of heat), using enriched uranium fuel elements and ordinary demineralised water at atmospheric pressure as moderator. It will be used to study the detailed behaviour of neutrons in water-moderated core designs, with specific reference to a pressurised water reactor for submarine propulsion, and to check the design calculations for the land-based prototype submarine reactor to be built at Dounreay. To this end the arrangement of the core is flexible and the temperature of the 3000 gallons of water moderator can be varied up to about 90 deg. Cent. by a 150kW heater, and the behaviour of various core arrangements at various temperatures can be studied. The top shield of the reactor can be removed to allow access to the reactor vessel and core. The reactor has been designed to allow rapid assembly of many different kinds of core (boxes of fuel element plates assembled inside a large heavily shielded aluminium tank containing water). The level of the water in the tank can be adjusted precisely to any required level and is used as one means of regulating the reactor. An additional method of control is by a neutron-absorbing cadmium rod, moving vertically in or out of the reactor core. The reactor is shut off by allowing two groups of neutron-absorbing plates to fall into the core, and by dumping the water at the same time into storage tanks beneath the reactor. The work of " Neptune " will be done by the Admiralty team at Harwell in association with Atomic Energy Authority staff



Our top illustration shows a member of the staff examining the foil holder. The foils are of manganese or indium, and are used to measure the neutron flux in the reactor. The horizontal beams carry the 10×10 array of fuel elements, and the pulleys actuate the aluminium-clad shut-down absorbing rods. In the centre illustration, the centrifugal pumps are shown under adjustment. There are two trips, one operated when the doubling time of the reactor reaches a preset value, the other when the neutron flux reaches a preset level. The control panel is shown in our bottom picture

Sixty Glorious Years

By S. B. HAMILTON, Ph.D., M.I.C.E., M.I.Struct.E.*

On Wednesday evening, Dr. Hamilton delivered to the Newcomen Society the third Dickinson memorial lecture. His subject was "The Impact of Engineering on Society in the Reign of Queen Victoria." The early part of the lecture reviewed the state of engineering development prior to the "sixty glorious years." Here, we print extracts from the three principal sections into which the remainder of the lecture was divided.

BY the time Queen Victoria came to the throne in 1837, the coal, iron and textile industries had emerged from the first great phase of their revolution. Other industries were rapidly changing and expanding. In Lancashire and the West Riding of Yorkshire there were, in 1835, 1369 steam engines and 866 water-wheels.[1] The middle-class merchant and manufacturer had won their right to representation in Parliament, and the control of many centres of local government. There were railways to the north, and projects to build them in many other places. But everywhere growth was patchy and uneven. As samples of the changes taking place let us consider the use of machine tools, the growth of the railway network and the supply of clean water to, and the removal of sewage from, the rapidly growing towns. These three developments probably exerted greater influence on the habits of society than any other work for which engineers of the period were responsible.

Machine Tools, 1830–60

By about 1830, most of the main types of machine tool had been invented and used by the inventors in their own works. The machines were driven by belts from shafting operated by a steam engine. By 1840, according to Dickinson, the making of machine tools was well on the way to becoming an industry.[2] Sir William Fairbairn (1789–1874) recalled in 1861 that, at the end of the Napoleonic wars, all machinery and mill equipment was made by hand. "There were," he said, "neither planing, slotting nor shaping machines ; and with the exception of very imperfect lathes and a few drills the preparatory operations of construction were effected entirely by the hands of the workman." By 1861, nearly everything in the manufacture of machinery was done with machine tools ; this had come about within one man's working life.[3] It had, moreover, been the result of the work of a small number of men, pre-eminent among whom stands Henry Maudslay (1771–1831). While still working with Joseph Bramah, Maudslay had converted the slide lathe from a watchmaker's and jeweller's appliance into the powerful, principal machine in the engineer's workshop. A diary kept by Maudslay's partner, Joshua Field (1787–1863), on a tour he made in 1821 through the Midlands, confirms Fairbairn's statement and shows the impending change beginning.[4] Field was shown round the works of the Horseley Coal and Iron Company by Aaron Manby, who had been their managing partner since 1813. The works made considerable use of steam power. Field saw a Wilkinson boring bar that would bore a cylinder 8ft in diameter, and a machine for screwing bolts and tapping nuts. There were five or six punching machines that could punch one hole at a time, or serve as shears. Such machines, operated by cam and lever, were, so Field said, used then by every boiler-maker in Staffordshire. By about 1830, Maudslay had built a powerful lathe with a face plate 9ft in diameter on which a 20ft flywheel could be turned, or a cylinder 10ft in diameter be bored. He had also markedly increased the accuracy of the lathe lead screw.

The shops of Maudslay, Son and Field not only turned out first-class work, but were the training ground for men who later made their own mark as craftsmen, inventors and manufacturers in their own right. Joseph Clements, chief draughtsman to Bramah, then assistant to Maudslay, later worked on his own. He began in 1828 the regular manufacture of taps and dies. He drew the refined and intricate parts of the calculating machines designed by Charles Babbage (1792–1871), and made them in his works. Richard Roberts (1789–1864), too, worked for a time with Maudslay, and later (like Clements) ran his own works in Manchester. He is best known as the inventor of the back-geared lathe, and as a pioneer of the extension of interchangeable parts to such heavy work as parts of locomotives in the works of Sharp, Roberts and Co. Le Blanc, in France, John George Bodmer, in Baden, and Eli Whitney, in the U.S.A., had already used this system for firearms. The British Government in 1853 installed a full equipment of tools and gauges at the new Royal Small Arms Factory at Enfield to do the same in Britain, having seen American examples of such work at the Great Exhibition in 1851.[5]

It was while working in Maudslay's that Joseph Whitworth (1803–87) produced his three true planes that made the production of a planing machine possible. In 1833 he, too, opened works in Manchester. There he spent six weeks perfecting a guide screw 30ft long for the lathe in which his first standard screw threads were turned. Later, he built measuring machines with micrometer movement capable of registering to a millionth of an inch, to test the accurate gauges indispensable for use in making interchangeable parts.

Another Maudslay-trained engineer was James Nasmyth (1808–1900), whose steam hammer was designed in 1839 to make practicable the forging of the paddle-wheel shaft of the "Great Britain." As that ship was actually built with propellers, the shaft was not made, but the hammer (patented in 1840) quickly revolutionised the process of heavy forging—indeed, made it possible. The hammer was adapted to pile driving, so used by the Admiralty at Devonport in 1845, and by Robert Stephenson for the pile driving at the High Level Bridge, Newcastle upon Tyne, in 1846.

There were purposes for which the power of steam was less suitable than pressure exerted by water. The high temperature and the expansive power of steam could prove extremely dangerous in case of sudden release leakage or failure. Water, virtually incompressible, and used cold, merely ceased to act in similar circumstances. Hence, the many ways in which the principle of Bramah's hydraulic press (patented 1795) came to be applied. One of these was a hydraulically operated testing machine installed in 1813 at Brunton's chain and cable manufactory at Musselburgh, to "prove" the strength of anchor cables. The test load was calculated from the fluid pressure. This gave too high a value, as the friction between ram and leather packing was considerable. About 1821, Telford's chain links for the Menai Suspension Bridge were tested on such a machine. A few years later, Samuel Brown (1776–1852) persuaded the Admiralty to use wrought iron chain cables instead of hemp. At Pontypridd, to test the chains, he built a geared machine in which the load was measured by means of a weighted knee lever. About 1825, Lagerjhelm, of the Stockholm School of Mines, and Professor Peter Barlow (1776–1862), of the Royal Academy, Woolwich, combined hydraulic loading with measurement by weighted lever. With a machine working on those same lines, William Fairbairn, Eaton Hodgkinson and Edwin Clark, between 1840 and 1846, made exhaustive tests on girders for Robert Stephenson (1803–59), who was considering the design of the great tubular railway bridges at the Menai Straits and at Conway.

Each tube, with its lifting gear, weighed nearly 2000 tons, rather more than half of which had to be carried by one jack. The remainder of the load was shared by two smaller jacks. One of the latter actually broke in service and let fall its load, but the precautions taken to follow up the movement by packing prevented serious damage to the girder. Rivets for the Britannia Bridge were nearly all driven by hand ; those of the Conway Bridge by a novel steam riveting machine.

Not only were machine tools, lifting appliances and the like improved in quality and increased in size, but the power transmission in engineering workshops and in mills was greatly improved. When, in 1817, William Fairbairn and his partner James Lillie set up their works in Manchester, shafting usually consisted of cast iron of square section running at 40 r.p.m. Fairbairn started to use wrought iron shafts, running at double or treble that speed, with improved couplings, hangers and standardised pulleys. By 1840 shafting in mills was being run at speeds of 300 to 350 r.p.m. Up to that time the engines were still being supplied with steam from Cornish single-flue boilers, such as first made by Trevithick. In 1844, Fairbairn introduced the Lancashire double-flue boiler. About that time also, multiple-punching machines and riveting machines became available to the boiler-maker. Later they were adapted by the builders of iron ships and of wrought iron girders and bridges. They were indeed used on the Britannia tubular bridge (1850).

The Royal Arsenal, Woolwich, affords an example of the sort of development that took place in many British establishments about the time we are considering. In 1842 it possessed two steam engines which, between them, developed 32 h.p. and drove a few machines used to saw and plane the timber for gun carriages. By 1857 there were sixty-eight steam engines, with a nominal total capacity of 1170 h.p. They drove 16,500ft of shafting, to operate 2773 machines of various sorts and supplied power to sixty-four hydraulic presses. Steam was also supplied to eighteen steam hammers.[6]

The introduction and development of machine tools up to the middle of the nineteenth century was brought about by a very small number of men. They employed large numbers as their work expanded, but these had to be trained and only they could train them. With these tools, British industry was

* Past president of the Newcomen Society.

re-equipped with machinery built of metal instead of wood, and Britain became "the workshop of the world." That, of course, could not last. Before long, machinery was made for export. Then machine tools were exported to makers of machinery abroad, and, indeed, men sent to install these tools and machinery settled abroad in far from negligible numbers as a few pioneers had done a generation earlier.

The Railway Network

Expanding industry, with its need for raw materials and for the distribution of its products, aroused an acute problem of communications. Navigable rivers, roads and canals were supplemented by horse-drawn vehicles on tramroads and by the opening years of our period, not a few private tramroads had developed into public railways. Steam-driven vehicles had been tried on the roads, rejected and taken up by the railways. The engineering shops we have just been considering were built up from small beginnings almost entirely by the thrift and industry of their proprietors, most of whom would have been unable to borrow large sums of money. Even a short railway, however, required considerable capital expenditure before it could begin to earn revenue.

Mine-owners, merchants, manufacturers and landowners had, therefore, to pool resources and to obtain Parliamentary powers to construct the lines. By 1835, nearly 1000 miles of line had been sanctioned and some of them built. Another 1000 miles were approved in 1836, and over 500 miles in 1837. By 1844, over 2000 miles of line had actually been opened to traffic. They included the London and Birmingham, the London and South Western, and the Great Western main line from London to Bristol, engineering achievements that so impressed the financiers of the City of London and Members of Parliament that, between 1844 and 1847, there occurred the orgy of speculation known as the "Railway Mania." "Lawyer's clerks, surgeon's apprentices, officers in the Army and Navy," so Sir John Rennie recorded, became engineers (so-called) and put forward schemes or undertook to carry them out.[7] Some of the schemes were unworkable. Some submitted simultaneously traversed the same district. Many were refused sanction to build. Amalgamations flourished. Lawyers were kept busy floating companies and winding them up; some collected enormous fees. So, added Rennie, did those engineers who were fortunate enough to get paid. He at one time employed on railway work, in one capacity or another, above 300 assistants; but before he could balance accounts, most of the companies who engaged his services had vanished, leaving their debts unpaid. An Act of 1844 laid down the terms on which, at some future date, the whole railway system could be nationalised. A Royal Commission of 1845 recommended a standard gauge of 4ft 8½in, that to which the Stephensons had laid their lines, and turned down the principal rival, the 7ft gauge to which I. K. Brunel had laid his, but the sponsors of the broad gauge only finally gave up the struggle in 1892.

The first American railroad was laid down in South Carolina, between 1830 and 1834; the first on the Continent of Europe in 1831—Marc Seguin's line from St. Etienne to Lyon. Lines in other countries followed in quick succession. In Britain, even at the height of the railway mania, good work was done. The great stations at York, Derby and Newcastle upon Tyne may have looked like the conceptions of a megalomaniac at the time, but they have proved a boon to posterity as well as a monument to George Hudson, the "Railway King," the most notorious of the promoters. His railway strategy, too, was on the whole sound, though his financial operations were highly irregular. As the law relating to company flotations was, at that time, in a state of flux and limited liability in its present-day form was only regularised in 1862, the injudicious shareholder had no reliable protection. A large-scale financial scandal meant utter ruin to many; panic was followed by widespread bankruptcy. Losses from the railway mania were enormous, but so resilient was Britain's economy that the collapse of many schemes, financially or strategically unsound, seems to have done little to halt progress in covering the country with a network of useful lines, for by 1850 over 6000 miles, by 1860 over 10,000 miles, and by 1870 over 15,000 miles, had been opened. After that progress continued, but at a diminishing rate. By the 1920s, at the peak, more than 20,000 miles were being operated, but since then there has been a decline as some non-remunerative branch lines have been closed.

The effect of the coming of the railways was immense. One after another, areas hitherto isolated and remote became readily accessible. The lines developed at first mainly for mineral and goods traffic soon became the normal channels of travel for people. The stage-coach, always expensive and thus limited to people of means, was replaced by the comparatively cheap passenger train, and folk who had never left their native county or town began to travel on business and even for pleasure. Leaving one locality to settle in another was no longer restricted to the wealthy, the destitute and the exceptionally adventurous. Postal services became popular. The evident need to control the movement of trains, particularly as many places were served by single tracks at first, led not only to signalling by semaphore, hitherto used almost exclusively for transmitting military messages, but also to the installation of the electro-magnetic telegraph, invented in 1836 by Sir Charles Wheatstone and used experimentally on railway work the following year.

Railway development brought a vast increase of traffic to the ports and led to a great deal of dock construction. Where no suitable authority was already in possession, the railway companies themselves undertook to build and administer docks at terminal harbours as at Southampton, Grimsby and Hull. Before long, the varied nature of railway work led to specialisation on the part of the engineering staffs.

When the Institution of Civil Engineers was founded in 1818, its field of interest included every branch of engineering activity; so did that of many of its early members. Both the volume and the complexity of engineering work, however, forced engineers of later days to specialise, but many did so with reluctance. I. K. Brunel never really did so at all. Every detail of the Great Western Railway construction, equipment and operation received his attention, including the design (though not successfully) of some of its earliest locomotives. His great girder bridges at Chepstow and Saltash, and the Clifton suspension bridge are still notable examples of construction and his iron steamships made history in naval architecture and in steam propulsion. The Stephensons were less adventurous and kept mostly, though by no means exclusively, to railways. George started on locomotives, but later left them almost entirely to Robert. But Robert had a large share in the design of such notable railway structures as the high-level bridge, Newcastle, and the Britannia and Conway tubular bridges. Joseph Locke (1805–60), a pupil of George Stephenson, carried out extensive railway construction in the Stephenson tradition in France. Brunel, George Stephenson and Locke were all elected Fellows of the Royal Society; Stephenson and Locke both became presidents of the Institution of Civil Engineers, and, what is more remarkable, both found time to serve as Members of Parliament.

All three died in 1859 in their fifties and thereafter but rarely did any one engineer attempt to take in quite so wide a sweep of activities as these three. Indeed, railway engineers tended to specialise either in the construction of the line and its structures, or in locomotive work, and in 1847 the locomotive men took the lead in founding the Institution of Mechanical Engineers, with George Stephenson as its first president, followed by Robert. The telegraph engineers founded their own society in 1871, a body that in 1899 became the Institution of Electrical Engineers. It is not recorded that either Robert Stephenson or Locke made any outstanding contribution to legislation, but the fact that they were elected to Parliament, and that both served on and gave evidence before a very large number of Commissions shows that in the mid-nineteenth century an engineer could be accepted as a person of authority and influence. He clearly had something of importance to contribute to the conduct of public affairs. His work also affected the employment of a very large number of people. The railway builders took over from the canals, and expanded, a labour force accustomed to rough, hard work, often in inclement weather—the navigators or "navvies" as they had come to be called. By pick, shovel and wheel barrow they moved millions of tons of earth. An army of bricklayers also followed the track to build viaducts, abutments, retaining walls and the lining of tunnels. Thousands of miles of rails came from the puddling furnaces before the first Bessemer converter went into production in the late 1860s. The contractors who successfully organised these activities gained experience that enabled them in the later decades of the century to undertake work in every part of the world, work that led to substantial exports, visible and invisible.

Public Health Engineering

In England, up to the eighteenth century, the life of the country labourer and his family could be precarious; comfort was meagre, and the death rate was high. Usually, in the country there was food for all, but a run of bad seasons could mean malnutrition, or even actual starvation. There was nowhere else to go or means of going other than vagrancy. New methods of husbandry, introduced with the enclosures greatly increased agricultural productivity, but needed less labour. Some unemployed men found work in making roads and canals. As factory production replaced home industries, others collected together their scanty personal belongings and sought for work in the towns. In most of the growing manufacturing centres there was overcrowding, sanitary arrangements were inadequate and water supplies tainted. Garbage (and even ordure) was often left in heaps for farmers, returning from market with otherwise empty carts, to collect for what value it might have as manure. Much found its way into rivers whose banks became too foul to be effectively cleared by summer rains. The river, more-

over, was also in many places an important source of water supply.

Cholera, endemic in India, had crept across Europe and in 1831 struck England on such a scale as to arouse panic. Public-spirited citizens urged that something must be done ; but what ? Nothing less, said Edwin Chadwick (1800–90), secretary to the Poor Law Commission, than the carrying away by water and below ground of all human excreta, the regular collection and removal from houses and streets of all other refuse, and the placing of responsibility for the necessary works in the hands of properly qualified engineers. Chadwick's solution may seem obvious enough to-day, but then it was revolutionary and visionary. Such public sewers as there were had been provided to take only storm water ; to turn sewage into them was in most places forbidden. Water closets were in limited use, but their effluent generally accumulated in a cess-pit in the yard, or under the house, whence it was cleared from time to time (if only when it overflowed). When connection to the sewers was allowed, as it was in London after 1815, the fall in many of these proved to be too slight and irregular to ensure that the solids were kept moving. To implement Chadwick's proposals most towns would require : powers to levy rates to pay for engineering works ; staff with the knowledge and experience, first to construct, then to operate and maintain the works needed to ensure a plentiful supply of clean water pumped and distributed by pipes ; a complete new system of sewers, including the hygienic disposal of sewage ; and, finally, powers to compel property owners to connect their outfalls to the sewers when provided.

Naturally, the local authorities objected that the whole complex of ideas was impracticable. However the law might be changed, medical officers of health and borough engineers did not exist ; neither did the means to train them. Chadwick himself was qualified in neither respect ; he was a lawyer. But if better qualified people were unwilling to act, that did not deter him. Sewers were traditionally of brickwork. Chadwick suggested that for the connecting branches, smaller sections of pipe would be cheaper and better. Unfortunately, the agricultural field-drain pipes available were weak, irregular and not always well laid ; their failure when used as house drains led to derision by Chadwick's opponents. Fortunately, Henry Doulton of Lambeth came to his aid by starting to manufacture a strong " stoneware," or vitrified pipe.

Filtration, and the removal of intakes upstream, above the tidal limit of the Thames, solved in the 1850s the problem of clean water supply for London,[8] but the foul and smelly river remained. In 1847 the Government had appointed the first of a succession of short-lived Metropolitan Commissions of Sewers to supersede the eight separate Commissions hitherto responsible for sewers each in its own allotted area. Potentially this was a great improvement, but as one of the Commission's first acts had been to abolish cesspools and turn their contents into the sewers, the state of the river had become worse than ever. In response to the Commission's invitation, no fewer than 116 schemes for main drainage were submitted and examined. In 1856 the Metropolitan Board of Works was formed to take over, from the sixth of the Metropolitan Commissions that had been appointed within nine years, the responsibility for London's sewers. Joseph William Bazalgette (1819–1891) who had been chief engineer since the fifth Commission, was retained as engineer to the Board, and it was he who designed, and between 1859 and 1864 carried out, the major part of the final scheme that still serves London to-day.[9] Its main feature was a system of main intercepting sewers that, both north and south of the river, were laid at three different levels to avoid unnecessary pumping. The effluent was collected in tanks for discharge just after high tide. The work included the construction of 1300 miles of sewers and eighty-two miles of intercepting sewers. It absorbed 318 million bricks and nearly a million cubic yards of concrete. It was the first great public works in which portland cement was used on a large scale.

Until about 1840, even the large provincial towns had no officer responsible for sanitation. The Towns Improvement Clauses Act of 1847 (10 and 11 Vict. c34, s7) authorised the appointment of " a person duly qualified to act as local surveyor of the paving, drainage and other works authorised under the provisions of this and the special Act." This provision was confirmed by the Public Health Act, 1848, and duly embodied in the Public Health Act, 1875 that remained the principal relevant Statute until well into the twentieth century. The Act of 1848 instituted a General Board of Health to consist of the First Commissioner of Works and two others, with power to appoint Superintending Inspectors who should make local enquiries and report. The two Commissioners appointed to the General Board were Edwin Chadwick and Lord Ashley, later Earl of Shaftesbury, but their appointments lapsed in 1854. As, however, that year was also marked by a third visitation of cholera, the work of improving sanitary services in towns was not halted as it might otherwise have been. They had appointed 182 local Boards of Health, mostly existing town councils, with power to levy rates and to appoint a Surveyor, an Inspector of Nuisances, a Clerk, a Treasurer and a Medical Officer of Health.

It would be interesting to know where all these new officials came from, and what qualifications it was possible to demand from the first batch of candidates. Some light is thrown on this question by Sir Henry Acland in an address he gave in 1876 at Oxford to a conference called by the Association of Municipal and Sanitary Engineers and Surveyors, a body founded in 1873 and since reconstituted as the Institution of Municipal Engineers.[10] Acland was a Fellow of the Royal Society, Regius Professor of Medicine in the University of Oxford, and President of the Medical Council of the United Kingdom. He had been forced, he said, by the Local Acts (presumably about 1850) to become officially a Street Commissioner. Oxford was at that time an undrained town in a sodden valley riddled with cesspools in the midst of shallow wells. The waterworks pumped up, with an uncertain and infirm waterwheel, a liquid fouled by the overhanging privies and filthy ditches of the slums of the city. What drains there were had been rudely constructed in gaping brickwork. The administering Board had no power to raise money to remove these evils, even had they been competent either to cope with the evil, or even to appreciate the risks. Thirty years were to pass before anything effective could be set going. But now he was addressing a body of engineers, specialists in that class of work. The man who was coming to be called a Borough Engineer was often, however, still the old " Surveyor " we all remember, the plodding, energetic man of highways and byways, whose Anglo-Saxon vigour broke forth from the garb of corduroy, from the measuring-tape and links, into the transcendent skill of Macadam ; and whose followers take rank with men of courage, and knowledge, and power, such as Brindley, Smeaton, Rennie and Stephenson.

Conclusion

Many more examples could be given of the impact of engineering on society in the later nineteenth century, such as that of the growing use of steel, the steam turbine, the generation and distribution of electrical power, but enough has been said to show that the times made more and more call on the services of the engineer ; that he always answered the call, and was sometimes ready with new developments long before the public or its rulers had recognised the coming need : that indeed the community became more and more indebted to, and dependent upon the services of engineers in all sorts of ways. Every form of manufacture depends upon machinery and power to keep it running and skill to maintain it. Every branch of trade depends upon reliable transport. Cities would become, as they nearly did in the 1840s, death traps were it not for the sanitary services, ever increasing supplies of water, gas and electricity, all of which were brought into being, and can only be kept going by the work of engineers.

Much of the early work was wasteful. They had first to find out how things could be done at all, before they could learn how to do them really well ; but the good engineer is never satisfied with current performance ; he is always striving for greater efficiency and economy. In that sense, his work is never done. The reign of Queen Victoria was a period of great expansion in engineering ; of extension of engineering into many new fields ; a bridge between the days in which engineering was mainly a matter of skilled craftsmanship and the present century in which it is largely applied science. For most of the nineteenth century, science had about as much to learn from empirical engineering as engineering had to learn from science. That gave it an element of adventure for men of action who were also men of intellect.

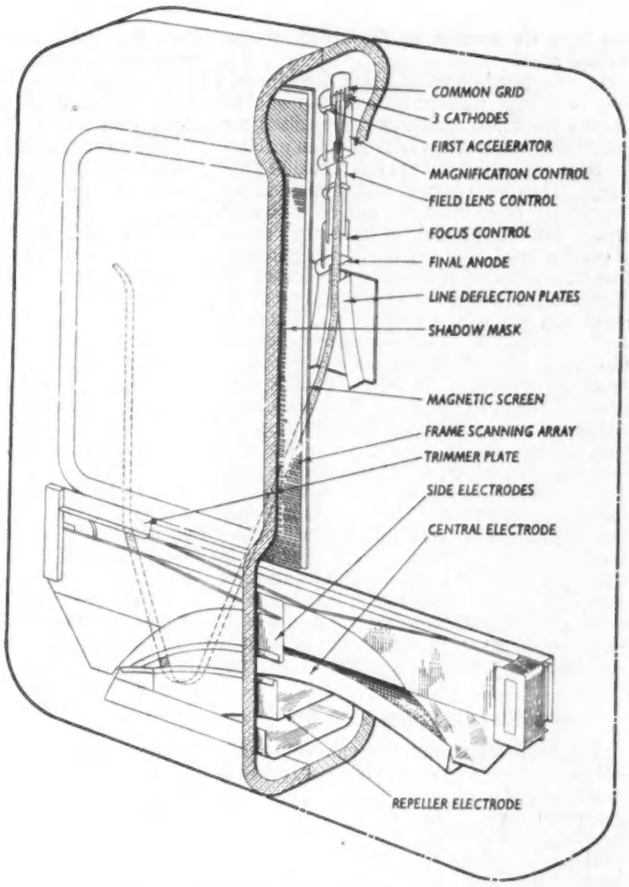
The times in which such men worked may well be called, for engineers as for Empire builders, sixty glorious years. For good or ill, the great Empire has fallen apart ; though not least among the legacies Britain has made to the states she has made independent of her rule are the magnificent railways, bridges, barrages and harbours built by British engineers. In present-day construction, British engineers are still to the fore, but if they are so to remain, the profession will need all the brains, initiative and character in its entrants that it was able to call on in the past. The lives of the great Victorians can still serve as an example, and perhaps a corrective to the bookish and mathematical trend of some engineering instruction. If the spirit of the great Victorians can still animate the youth of Britain to-day, they may lead lives of equally glorious achievement. We can wish them no destiny more worthy or more satisfying.

References

[1] Knowles, L. C. A., *The Industrial and Commercial Revolutions in Great Britain During the Nineteenth Century*, 1922, 73.
[2] Dickinson, H. W., " Machine Tools in 1847," *Engineering*, June 6, 1947.
[3] Fairbairn, Sir W., Presidential Address in *Brit. Assoc. Report*, 1861.
[4] Hall, J. W., "Diary of a Tour by Joshua Field in the Midlands, 1821," *Trans. Newcomen Soc.*, 1925–6, VI, 1–41.
[5] Roe, J. W., " Interchangeable Manufacture," *Trans. Newcomen Soc.*, 1936–37, XVII, 171.
[6] Note in THE ENGINEER, February 1, 1957, 203 (5271), 161.
[7] Rennie, Sir J., *Autobiography*, London, 1875, 295.
[8] Dickinson, H. W., " The Water Supply of Greater London," Newcomen Soc., London, 1954.
[9] Bazalgette, J. W., " On the Main Drainage of London," *Min. Proc. Inst. Civil E.*, 1864–65, XXIV, 280–358.
[10] Acland, Sir H., " The Relation of Modern Engineering to Public Health and Local Government," *Proc. Assoc. Mun. and San. Eng. and Surv.*, 1875–76, 111, 160–175.

New Television Tube for Monochrome or Colour

A new flat c.r. tube for monochrome or colour television was described in a paper by D. Gabor, Dr.-Ing., F.R.S., M.I.E.E., P. R. Stuart, Ph.D. and P. G. Kalman, discussed before the Institution of Electrical Engineers, London, on May 14. This tube has been developed by the authors in the electrical engineering department of the Imperial College of Science and Technology, London. The work, which is sponsored by the National Development Research Corporation has now reached a stage beyond which it cannot readily be taken by post-graduate students in an academic laboratory. The following abstracts from the paper give a general description of the tube and of the self-scanning principle upon which its operation depends.



A FLAT, thin television cathode-ray tube for monochrome or colour, whose thickness is only about one-quarter of its screen diagonal, has been developed by the authors to the point at which the feasibility of its essentially novel features could be tested singly, and partly in combination. In the flat tube the electron beam—and in the case of a colour tube, three beams—issuing from the same gun is launched vertically downwards. A line-deflection system imparts to it a pendulating motion in a vertical plane, and a reversing lens turns this plane by 180 deg., increasing the deflection angle by a factor of about 4. Just before reaching the screen region the beams are turned into the vertical direction by a magnetic collimator. The beams now enter a narrow space between the phosphor screen and a "scanning array," consisting of parallel, horizontal conductors, arranged in a plane parallel to the screen. At a certain level the beam is thrown against the phosphor screen by an electric field, which travels downwards with the speed of the frame scan. This travelling field is produced by the beam itself, which, in the intervals between line scans, falls on the conductors of the array in a narrow zone, discharges them, and thereby pushes the field to a lower level. Recharging of the array after the frame is also effected by the electron beam, making use of the secondary emission of the array conductors. This is the principle of self-scanning. Colour is produced by shooting three beams on parallel lines and close together into the screen region. The deflecting field between screen and array acts as an efficient short-focus lens, and unites the three beams in one small spot at the screen, which they approach at different angles. Colour discrimination is produced by a line shadow mask about 0·5mm only from the screen, and fixed to it by means of small, invisible bridges. This also serves as a mask in producing the colour-phosphor strips by a powder-settling process in air. The extensive electron-optical development work is described in detail, and mention is also made of special technological problems raised by the new c.r.t. design, and of their solution.

General Description of the Tube

In conventional cathode-ray tubes, ever since the days of Ferdinand Braun, the beam approaches the screen in a straight line, like a pencil pivoted by its end. In the new flat tube, the beam is folded over on itself, and runs for most of its length parallel to the picture screen, bending towards it only on the last short section of its trajectory.*

The tube, shown schematically above, is an all-glass version of a colour television tube, but it will be convenient to leave the explanation of the colour production for later. The tube is essentially a flat glass box, with a depth of about 3½in outside, 2in inside for a screen with 12in diagonal. It is divided in depth by a base-plate, on which are mounted all the electrode structures, and which, in turn, is carried by four elastic metal rods let into the joint of the two glass shells. It is preferable to make this plate of a material with high magnetic permeability, such as "Permalloy," so that it may act at the same time as a very efficient magnetic screen.

The electron gun can be conventional in the monochrome version; the special gun for colour tubes will be described [later in the paper]. It is mounted behind the partition, near the top, and launches the electron beam vertically downwards. The beam passes through the line- or X-deflection plates, so that it swings parallel to the plane of the base-plate, in the rhythm of the line scan, with an angular excursion of about ±15 deg.

The gun and X-deflectors are more or less conventional, but the beam next passes into a new type of electron-optical element, called the reversing lens. This is a somewhat complicated electrode structure, the discussion of which will take up a good part of the paper, but for the present it will be sufficient to mention two of its many functions. The reversing lens rotates the plane formed by the fan of rays issuing from the deflector by 180 deg. into another plane, parallel to the picture screen, while increasing the divergence angle of the fan by a factor of about 4. This means that, on leaving the reversing lens, the deflected rays sweep through an angle of about 120 deg. Owing to this large divergence, the beam sweeps out the whole horizontal width of the picture only a few inches above its lowest point. At this level the beam passes through another novel structure called the collimator, which is the only magnetic element in the otherwise purely electrostatic electron-optical system. This can be considered as a very powerful flat lens, which collimates the rays, i.e. it sends the beam exactly vertically upwards, into the space between the base-plate and the luminescent screen.

The base-plate carries, near its front face and spaced from it by a few millimetres, an electrode structure called the scanning array, as shown in the accompanying illustrations. The purpose of this device is to bend the beam towards the screen at a certain level, at the same time focusing it, and to sweep

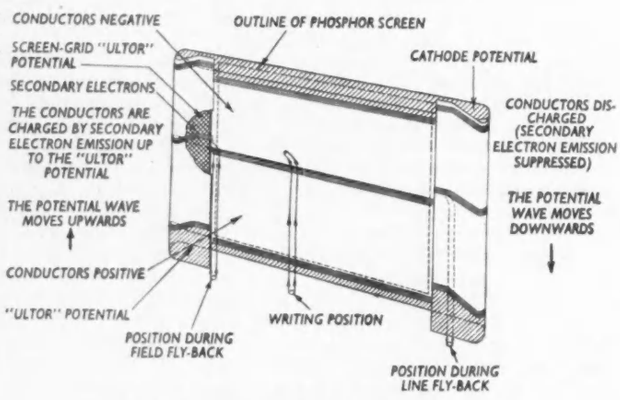
* Launching the beam parallel to a phosphor screen and deflecting it by an electrostatic travelling field towards the screen was independently proposed by one of the authors[1] and by the American inventor W. Ross Aiken (first Patent Application, May, 1953). Apart from this basic common feature the flat tubes developed by Aiken and by the authors are different in every respect. In the Aiken–Kaiser tube, both the line and the frame scan are effected by waves travelling along a relatively small number of electrodes (10 and 7, respectively), which are driven by outside circuits. Colour is produced by two beams scanning a thin transparent double-sided phophor screen. Particularly interesting is a completely transparent tube fixed on the windshield of an aeroplane, which was successfully tested in flight[2] in August, 1957.

this level downwards at the speed of the vertical scan.

As illustrated, the scanning array consists of a large number (about 100) of thin linear conductors, which can be realised for instance by metal strips printed on an insulating base, and which are not connected to anything. They are charged and discharged by the writing beam itself, as will be explained later. For the present, assume that up to a certain level (the lowest of the group of four lines explicitly shown in the middle of the diagram) the conductors are charged up to the maximum positive potential V_m, which is also the potential of the luminescent screen. Up to this level, therefore, the electron beam proceeds vertically. Above a certain level (the top line of the group of four) the potential may be, say, $\frac{1}{4}V_m$, i.e. strongly negative with respect to the screen, while the four lines themselves represent a transition region. The trajectories will then curve towards the screen in this region. The beam is not only bent but focused ; this is the effect of "deflection focusing," which is well known in television tubes as a serious disadvantage of electrostatic deflection, and is here made to serve a useful purpose. We will deal with it [later in the paper] in more detail, since it is the basis of colour production in the flat tube.

The Self-Scanning Principle

The diagram also shows the second function of the array—the vertical or frame scan which is effected by the writing beam itself. The scanning array forms U-shaped loops at both sides of the picture area, and in this region the conductors are slanting upwards, terminating in horizontal sections, which are staggered upwards by a certain amount relative to their long, horizontal central sections. As long as the beam remains inside the picture area, the charge of the conductors remains unaltered, and hence the spot describes an exactly straight horizontal line. But when a line scan is finished, the beam moves into the loop at the right-hand side, and here, if the stagger is properly dimensioned, the beam will spray one or several conductors in the transition region. The area opposite this is at a lower potential and acts as a suppressor of secondary electrons. In consequence, the sprayed conductors are discharged by the full amount of negative electron charge which they collect from the beam. This causes the transition region to move downwards, and hence the next line sweep of the spot will be at a somewhat lower level. If the beam current during the time between two line sweeps, while the beam rests in the loop at the right, is properly dimensioned, the spot will move down just by a step of the desired length.


CONDUCTORS NEGATIVE
SCREEN-GRID "ULTOR" POTENTIAL
SECONDARY ELECTRONS
THE CONDUCTORS ARE CHARGED BY SECONDARY ELECTRON EMISSION UP TO THE "ULTOR" POTENTIAL
THE POTENTIAL WAVE MOVES UPWARDS
CONDUCTORS POSITIVE
"ULTOR" POTENTIAL
POSITION DURING FIELD FLY-BACK
OUTLINE OF PHOSPHOR SCREEN
CATHODE POTENTIAL
CONDUCTORS DISCHARGED (SECONDARY ELECTRON EMISSION SUPPRESSED)
THE POTENTIAL WAVE MOVES DOWNWARDS
WRITING POSITION
POSITION DURING LINE FLY-BACK

Principle of self-scanning by a writing beam

It remains to be shown that conditions can be found such that the discharge wave moves downwards not only at the right speed, but without distortion, i.e. the process described is stable, and moreover that, by suitable choice of the stagger, the stable discharge wave can be made to have the right sort of profile required for effective focusing of the writing beam. This was verified experimentally, and a mathematical discussion is given [in Appendix 12.4 of the paper].

When the beam has run down and the array is discharged, it is recharged again by the writing beam. This is done by stopping the line scan and moving the beam into the loop at the left-hand side. This differs from the other loop by a somewhat larger stagger and by the presence of a screen grid between the beam and the terminal portion of the array. This screen grid is maintained at the maximum positive potential V_m, called the "ultor" potential, and therefore acts as a collector of secondary electrons. If the secondary yield, δ, of the array conductors exceeds unity, the effect is as if $\delta - 1$ positive electrons had landed on it instead of one negative electron, and the conductors charge themselves up gradually to the screen-grid potential V_m, while the beam moves upwards, to the top.

A metal strip called the "C-plate" is arranged at the top, and maintained permanently at a level near cathode potential. When the new frame starts, the line scan is switched on again, and the beam moves from the region of the screen grid into the region of the C-plate, which throws it against the luminescent screen. The C-plate is at such a distance from the top conductor that the scanning wave is, as it were "preformed," so that the run-down can start automatically, with the right waveshape and at the right speed. Interlacing is effected by giving the C-plate somewhat different potentials in alternate frames, so that the scan starts at levels differing by a line spacing.

An essential element in this self-scanning process is the good secondary emission of the array conductors in the section facing the screen grid in the left-hand loop. As television tubes are operated with voltages of 12–25kV, and the best-known secondary emitters have "sticking potentials" of 12–15kV, this might appear a very serious difficulty. In fact, it appeared so serious that rather complicated schemes were evolved for spraying the conductors with slower electrons, and also for recharging them by photoconductivity or by bombardment-induced conductivity. Fortunately these fears were unfounded. The data for secondary emission usually given in literature relate to normal incidence. The angle of incidence makes little difference with rough surfaces, such as fluorescent powders or magnesium-oxide smoke, but a very great deal for polished surfaces. Roughly speaking, an electron of energy W incident at an angle θ to the normal releases a comparable number of secondary electrons to an electron with perpendicular incidence and an energy $W\cos^2\theta$. Hence an electron of 20keV energy incident at 60 deg. is roughly equivalent to a 5keV electron. There exist a fair number of suitable materials which have secondary yields well above unity at 5keV "perpendicular energy," and the incidence can be easily made very oblique. We will return to this question later in connection with the technological problems of the flat tube.

Colour Control

A shadow mask, which is essentially a plane metallic structure with evenly spaced horizontal (or nearly horizontal) slits, is placed before the screen, which carries a system of phosphor strips in the three fundamental colours, red, green and blue, with one colour cycle per slit. The phosphor strips are so arranged that, at a certain angle of incidence, or near it, the electrons excite only one colour. This principle is well known, and has been widely utilised in existing colour tubes.

The advantage of the flat tube is in the dimensions. In the conventional colour tubes, in which three beams produced by three separate guns converge at an angle of about 6 deg. to one another, the distance of the shadow mask from the screen must be made about $\frac{1}{2}$in. In the flat tube, with incidence angles between 30 deg. and 60 deg. the distance is $^1/_{40}$in or even $^1/_{50}$in. Therefore, while in the existing shadow-mask systems, the shadow mask has to be fixed, with elaborate precautions, independently of the screen, but in accurate register with its line or dot pattern, in the flat tube it becomes possible to fix it on the screen surface itself, thus eliminating all possible distortions of the mask. Moreover, it now becomes possible for the first time, to stick the shadow mask on the screen first and produce the phosphor lines behind it in automatic register with the slits, by a simple method which will be explained [later in the paper].

There also exists a second possibility for exploiting the advantages of the flat-tube electron optics for colour production. It has been often proposed to use composite screens, formed by the superposition of three layers of colour phosphors, utilising the different penetration of electrons of different energies for differential excitation of the three colours. These suggestions failed for two reasons. First, it is practically impossible to focus three beams with energies of, say 5, 10 and 15keV simultaneously on all points of a television picture. The electron-optical problem is not so difficult in a sequential system, but frame-sequential systems are ruled out by their bandwidth requirement, and a point-sequential system in which the gun, or a fine grid near the screen, is modulated with a swing of $\pm$5kV in point sequence requires a high-frequency power supply of prohibitive size. Secondly, the effect itself is so impure as to be practically non-existent so long as powder screens are used, with the usual grain sizes of at least a few microns, i.e. about the total penetration depth of 15–30keV electrons.

The first difficulty does not arise in the flat tube. To a reasonable approximation the penetration depth of a fast electron is determined by its velocity normal to the surface. If the angle of incidence is θ the equivalent energy is $W\cos^2\theta$. If we assume that W=20keV and the incidence angles of the three colour beams are 30 deg., 45 deg. and 60 deg. respectively, this gives equivalent (normal) energies of 15, 10 and 5keV, and the coincidence of the three beams at the screen is, of course, ensured.

There now exists at least a possibility that

the second difficulty may also be overcome, since Feldman and his collaborators[3] have succeeded in producing grainless luminescent films by evaporation with very even thicknesses of the order of 1 micron, and have successfully demonstrated a two-colour screen in which both colours could be fully saturated by a voltage swing of 8–22keV. These almost fully transparent screens have also remarkable contrast ; the picture can be viewed in a room illuminated so brightly that a picture on a powder screen becomes completely invisible. However, there are some serious disadvantages. The present method is slow, since it requires lengthy baking after evaporation at temperatures which require the use of quartz or " Vycor " glass. Moreover the luminous efficiency of the transparent layers is about one-fifth of that of a powder screen of the same material, because the major part of the emitted light remains imprisoned in the thin layer, owing to its high refractive index. Nevertheless, a method of producing colour-television pictures without any shadow mask or other structure before the screen, and which at the same time allows pictures to be viewed in bright rooms, is too attractive to be dismissed out of hand, even if it gives an efficiency somewhat lower than that of the shadow-mask method.

[The authors then dealt with the electron-optical realisation of colour control ; the reversing lens ; the magnetic collimator ; and the technological features of the television tube.]

Conclusions

The development of the flat television tube for monochrome and colour has reached a stage at which the feasibility of every one of its novel features has been tested singly, and partly in combination. The major part of the work consisted in the development of the electron-optical system consisting of a three-beam electron gun, a line-deflector system, an electrostatic reversing lens and a magnetic collimator, which launches the three colour beams into the space between the phosphor screen and the scanning array, on three accurately parallel and equidistant planes, and ensures focusing along any scanning line without " dynamic " corrections. The second part was the development of a scanning array which enables the beam to effect the frame scan by itself. The third part was a simple method for producing the pattern of colour-phosphor strips, in automatic register with the shadow mask which is fixed immediately on the glass screen. The first two developments were tested in combination, and the third, for the time being, only on small samples of colour screens. Work was also done on the use of prestressed (toughened) glass plates, to enable the construction of large tubes of at least 20in diagonal with plane screens, without excessive glass thickness. All experiments were carried out in continuously-pumped, demountable vacuum tanks. No sealed-off complete tube has been produced so far, and this stage of the development would be more appropriately carried out in industrial establishments than in an academic laboratory.

References

[1] Gabor, D., U.S. Patent Application No. 309677, September 15, 1952 ; " A New Flat Picture Tube," *Journal of the Television Society*, 1956, 8, page 142.

[2] Aiken, W. R., U.S. Patent Application No. 355965. May 19, 1953 ; " A Thin Cathode Ray Tube," *Proc. of the Inst. of Radio Engineers*, 1957, 45, page 1599.

[3] Feldman, C., and O'Hara, M., " Formation of Luminescent Screen by Evaporation," *Journal of the Optical Society of America*, 1957, 47, page 300.

Gauge and Tool Exhibition

REPRESENTATIVE products of more than 120 of the leading gauge and tool manufacturing and designing firms in this country are to be seen at the Gauge and Tool Exhibition, which opened at Olympia, London, on Monday last, May 12. In order that the formal opening ceremony should not clash with that of the Production Engineering Exhibition, being held in an adjoining hall at Olympia, the formal opening ceremony was performed by Sir William Lyons on the following day. This exhibition, the fifth to be organised by the Gauge and Toolmakers' Association, has this time been extended to include the products of the Power Press Manufacturers' Association. Its scope and interest are further widened by the inclusion for the first time of some machine tools on which tools and equipments are being demonstrated under actual working conditions.

The gauge and tool industry has developed rapidly in this country in the post-war years, and by providing the requisite range of tools, jigs, measuring and other equipment, it has played an important part in enabling the increasing productive capacity of machine tools to be used to the full. Indeed, on the cutting tool side during recent years, the rate of development has been such that the machine tool maker has not always found it easy to incorporate the power and speeds in machines to take fullest advantage of the cutting potential of the latest tool materials. As in previous exhibitions, the cutting tool manufacturers are well represented and it would be difficult to think of any standard class of tool or cutter not being shown on one or more stands. Of interest also are some of the special form cutters, hobs and other tools exhibited, which give some indication of the problems of design and manufacture which are now presented to makers of high-precision cutting tools.

The very large number of jigs and fixtures exhibited include many interesting designs which have been developed for individual problems to provide quick and easy clamping with consistent and accurate registration for machining operations to close tolerances using semi-skilled or unskilled labour. The exhibits show how the use of such jigs or fixtures can provide an effective and economical means of carrying out batch production to close limits on general purpose machines, where the numbers required do not justify special purpose plant. In addition to the special purpose jigs there are also available component sets with which user firms can build up jigs to their own requirements if they so desire.

Gauging Equipment

An essential complement to efficient precision production is efficient gauging and measuring equipment, and the many well-known firms of plug, gap, thread, slip and other gauges, micrometers, verniers, and dial indicators are shown in large numbers. Supplementing these standard tools there are on view a number of the high-precision, multiple-dimension gauging equipments which have been designed to meet the demand for high-speed, accurate checking of components made at the high production rates of which modern machines are capable. Such gauging equipment has become an essential tool in production shops where a delay in checking can result not only in time loss on " first-off " inspection, but the making of scrap components between inspections during a short-cycle machining run. Gauge sizing devices, which are now made by several firms for use on such machines as precision grinders, have, of more recent years, been an important step in reducing production times, and the effectiveness of this class of equipment is demonstrated on some of the stands.

The comparators and multi-dimension inspection equipment shown by the Sigma Instrument Company, Ltd., Letchworth, Herts, includes this firm's " Sigmaster " equipment, intended for quality control on production machines. The equipment is supplied in the form of a kit of standard inspection units which can be readily built up to provide a gauging fixture to a particular requirement. A fixture built up from one of the kits can be seen in Fig. 1, where it is used in conjunction with one of the maker's " Liquicolumn " multi-dimension indicators. A " Sigmatrol " automatic size controller fitted on a cylindrical grinding machine on the stand demonstrates the application of the unit in providing automatic sizing on a shaft whilst it is being ground.

Another example of automatic size control on grinding machines is to be seen on the stand of Tolemit Gauges, Ltd., 16, Peterborough Road, London, S.W.6. Two " Matrix 1A " grinding machines fitted with air-electronic gauges are set up for cylindrical and shaft grinding to very close limits. With the size-control equipment used, the switching is carried out electronically using photo-transistors worked by the liquid in an air gauge column. It is stated that at standard magnification the control is accurate to within 0·000006in. This class of control

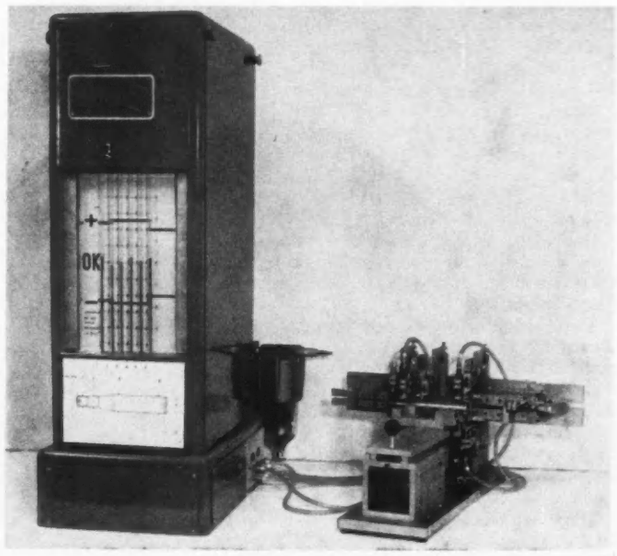


Fig. 1—" Sigmaster " multi-dimension inspection fixture—Sigma

equipment is also demonstrated as applied to an automatic gauging and grading machine.

A high-precision electrical comparator developed by Rubert and Co., Ltd., Chapel Street, Levenshulme, Manchester, 19, consists of an electric indicating dial gauge for automatic and semi-automatic inspection purposes. Three electric lights on this instrument indicate whether a component under test is within the required tolerance and shows the amount of error on a dial gauge. This firm has also developed a combined beam comparator and load deflecting measurement unit for checking the deflection of surface plates, and tables, when subjected to loading in accordance with the requirements of B.S. 817 : 1957.

This equipment can be seen in use in Fig. 2. It consists of a rigid beam which is supported at each end by an adjustable foot and is fitted with a sensitive dial indicator. A third foot, positioned centrally but slightly off-set, is used to keep the beam stable when it is positioned on a table. A central platform for carrying the requisite test weight is supported independently of the beam on a ring. The plunger of the dial indicator, which passes through this ring, bears down into contact with the plate on test and shows the degree of deflection imparted by the weight. With this instrument the inaccuracies due to

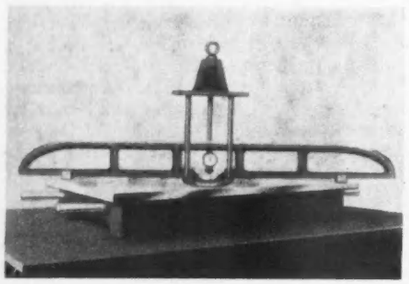


Fig. 2—Load deflection test equipment for surface plates and tables—Rubert

deflection under given loads on plates and tables in service in a works can also be precisely assessed and provisions made in final calculations. The equipment to this design is made in three standard sizes of 3ft, 6ft and 10ft, and larger sizes can be made if required.

A number of different applications in gauging set-ups are used by British Indicators, Ltd., Sutton Road, St. Albans, Herts, to show the versatility of the "John Bull" dial indicators. A dial gauge testing machine the company has developed is used for the continuous checking and recording on a graph paper the accuracy of its instruments. On this machine the dial indicator to be tested is mounted on a revolving table together with a sine bar which is traversed at a constant rate. A pen is attached to the hand of the indicator and as the indicator is rotated the pen records any deviations on a graph paper.

Two recently developed machines are shown by J. Goulder and Sons, Ltd., Kirkheaton, Huddersfield—a rolling gear tester and a lead measuring machine. The gear testing machine has a capacity of 32in between centres enabling gears up to about 4ft diameter to be handled. A saddle mounted on balls can be hand or power driven and is urged forwards during testing by a spring pressure which can be set at any value up to 20 lb. Variations of centre distance between the gears are shown on a 4in diameter dial gauge on the saddle and, if required, electrical

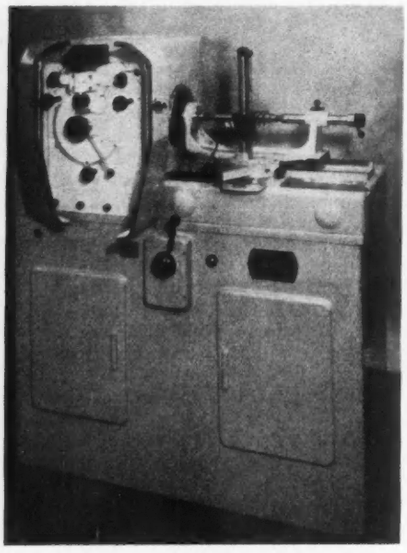


Fig. 3—Lead measuring machine—Goulder

recording apparatus with magnifications between 100 and 5000 times can be fitted on the machine. The nominal centre distance is set by a vernier and scale fitted on the machine.

The lead measuring machine, Fig. 3, is designed for the quick and accurate measurement of leads of gears ranging from those of straight spur design to worms. It takes gears up to 14in diameter by 5in long in the gap and 8in diameter by 7in to 12in long between centres. Leads from zero to infinity are checked over 3in axial movement in the machine.

A Taylor, Taylor and Hobson, Ltd. recorder used for showing errors of lead provides a range of magnifications from 100 to 5000 times; alternatively, a high magnification micro-indicator can be used. The quill of the generating mechanism is moved through a helix by a driving disc which is pressed against it. This disc is driven by a fractional horsepower motor, and through the construction of its mounting it can be presented at any angle to the quill. Thus the helix angle through which the quill moves is determined by the angle at which the driving disc is presented to it. The required leads are first set by a coarse setting lever and then to the precision limits by a knurled screw with reference to a microscope and circular glass scale. Short leads with a number of turns presenting a long developed path can be set with the microscope and checked precisely by means of a slip gauge holder attached to the spindle.

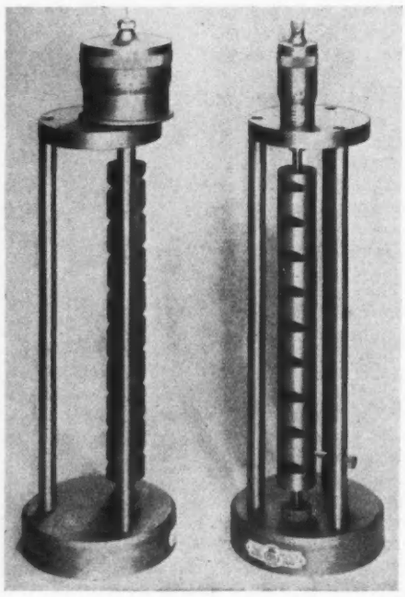


Fig. 4—Micro-bar-height-setting gauge—Pitter

With its well-known range of gauging and measuring equipment the Pitter Gauge Precision Tool Company, Ltd., Woolwich, S.E.18, is showing a recently-introduced micro-bar-height-setting gauge, Fig 4, which has been developed to eliminate need for arranging combinations of slip gauges or length bars for height settings. It is stated to provide height settings from 2in to 11in with an overall accuracy of 0·0002in. The setting bars are notched on both sides with the setting surface on the lower face of one series of notches, and on the upper face of the opposite notches. This double notching facilitates the setting of dial gauges for up or down checking.

A system of reducing wear of gauges by the application of a coating of tungsten carbide has been introduced into this country from the United States by John Harris Tools, Ltd., Warwick. This "Flame-Plating" process, as it is known, uses a special gun in which particles of tungsten carbide are suspended in a mixture of oxygen and acetylene. When this mixture is ignited, a detonation takes place which heats the particles to a plastic state and hurls them from the barrel to embed them in the surface of the workpiece. A welding action takes place and, by means of successive detonations, the coating on the workpiece may be built up to any desired thickness over a range from two to ten thousandths of an inch, and may if required be finished by standard diamond finishing methods to fine tolerances. A special advantage of the process is that, although the temperature of the gases inside the gun may reach as high as 6000 deg. Fah., the temperature of the workpiece rarely exceeds 400 deg. Fah. There is therefore little chance that a part being plated will warp, or that its metallurgical properties will be changed.

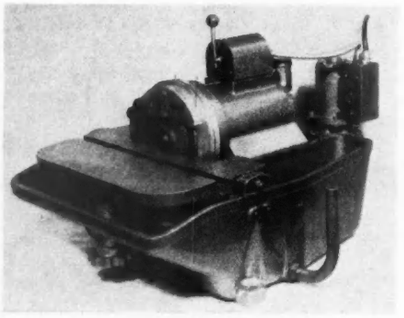


Fig. 5—Oscillating head grinding machine for carbide tools—Impregnated Diamond

In addition to the "Sparcatron" spark machining equipment and its well-known diamond tools, the firm of Impregnated Diamond Products, Ltd., Gloucester, is demonstrating the "Neven" oscillating head grinding machine for carbide tools. This machine—a bench model of which is shown in Fig. 5—uses a 6in diameter wheel with a $\frac{3}{32}$in or $\frac{1}{8}$in wide impregnated rim. The wheel is directly mounted on the spindle of a totally-enclosed reversible 1 h.p., 2850 r.p.m. motor of the maker's own design. The

grinding spindle and motor assembly is carried on pivot bearings in the main base casting of the machine, and through a crank disc is oscillated at 30 strokes a minute by a small separate motor at the rear of the machine. By adjustment of the crank disc connection, the degree of oscillation can be set at up to $\frac{5}{8}$in on either side of the centre line. If required, this oscillating movement can be cut out by operation of a switch.

The hinged table of the grinder has a $16\frac{3}{4}$in by 8in surface, and it is adjustable for tool rakes from +5 deg. to —15 deg. by means of a micro-setting screw. A slot in the table can be used for the fitting of a protractor if required. The base casting forms a coolant tank of 2 gallons capacity and a self-priming centrifugal pump supplies coolant at 8 gallons a minute. It is stated that, by using superfine grade wheels with the oscillating motion, tungsten carbide tools can be ground with a perfectly straight edge and a finish of approximately $\frac{1}{2}$ micro inch on the surface.

Presses

Some of the seven presses being shown by Taylor and Challen, Ltd., of Birmingham, are engaged in typical production work. One of these machines is a high-speed, double-roll feed press built for the continuous production of coin blanks. It is rated at 50 tons and has a speed range variable from 65 to 400 strokes a minute. Strip up to 8in wide can be handled on the machine, which has a maximum feed of 2in. If required, the rolls can be relieved every stroke to enable the use of follow-on tools when producing pierced blanks.

A high-speed notching press for making rotor laminations, made by the firm and shown in Fig. 6, is capable of up to 1000 strokes a minute. It handles rotor laminations of from $3\frac{1}{2}$in to 17in mean pitch circle. The machine is fitted with a redesigned indexing mechanism to impart a higher degree of pitch accuracy in operation, and the saddle is now fitted with micrometer adjustment. Mechanical feeding and ejecting for drawing presses is being shown on two presses: a horizontal press which draws cups up to $2\frac{1}{2}$in diameter and $9\frac{1}{4}$in long, and a double-action press which can be made to feed blanks up to 11in diameter and has a punch stroke of 10in.

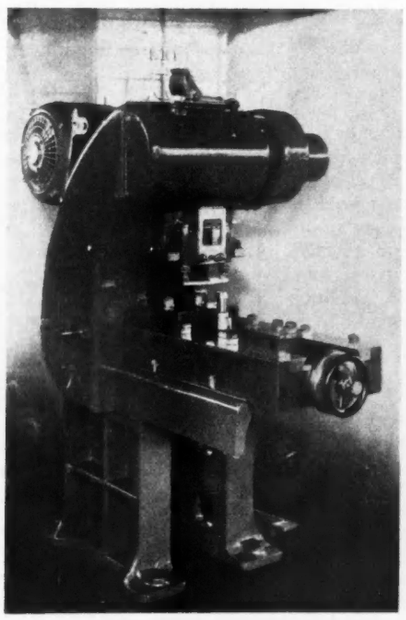


Fig. 6—Notching press for rotor lamination production—Taylor and Challen

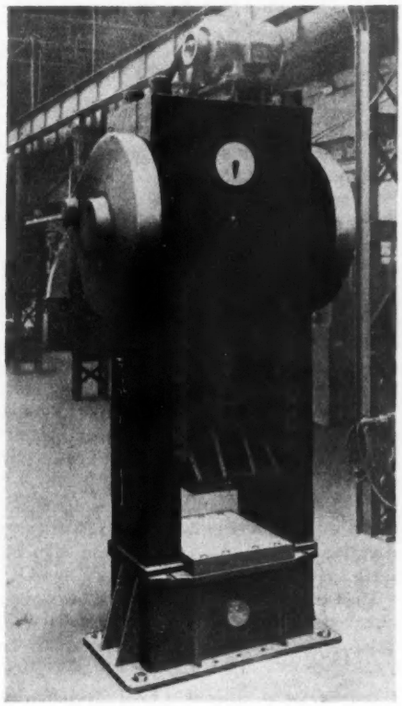


Fig. 7—250-ton press with completely enclosed gearing and transmission—Cowlishaw, Walker

An example of the "E.S.S." range of presses made by Cowlishaw, Walker and Co., Ltd., Biddulph, Stoke-on-Trent, is the 250-ton capacity machine shown in Fig. 7. In those new machines the complete gearing and transmission are housed in the crown member and the gears are completely encased. The machine is driven by a 30 h.p. slipring induction motor, and makes twenty-five strokes a minute. The length of stroke is 8in and a 3 h.p. slide adjustment motor is fitted.

The control of the press is through an air-operated clutch-brake unit which absorbs shock loads and permits easy inching for tool setting purposes. The air supply to the unit is controlled electrically through a low-voltage system. The air supply is admitted through a pilot-operated, solenoid-controlled valve, as is the normal practice, but an extra safety feature is in the provision of a second solenoid-controlled emergency exhaust valve which seals the clutch air. Normally this second valve is energised to the sealed position and the function of admitting and exhausting clutch air is carried out by the first valve. Through any pneumatic failure of the first valve or any electrical fault in the control circuit the emergency exhaust valve is de-energised to exhaust the clutch air when the crankshaft over-runs to a set tripping position. A monitoring circuit functions to cancel this emergency exhaust under normal working conditions and it is only operative under conditions of failure of the normal means of stopping the press.

A toggle action coining press made by Hordern, Mason and Edwards, Ltd., Tyburn, Birmingham, is designed to overcome certain disadvantages in the orthodox knuckle press. Its bed deflection is stated to be negligible as it is stressed in compression and not in bending, as is usual practice. The toggle mechanism is contained within a rectangular member which moves in long slideways. Elongation of the all-steel frame under load is registered on a clock indicator graduated in tons, so that the operator can check the pressure exerted at each stroke. Tool adjustments are made by a handwheel through a wedge assembly and the position of the adjustment is shown on a scale. All moving parts of the press are enclosed and lubricated by a circulating system. Another of the nine presses on this firm's stand is a 100-ton "Rigispeed" high-speed machine driven at 85 to 250 strokes a minute through a hydraulic variable speed gear.

The cam type automatic press feed unit of George F. Clark (Toolmakers), Ltd., Colham Mill Road, West Drayton, Middlesex, is driven by a shaft from the crankshaft of the press, as shown in Fig. 8. It is provided with six interchangeable cams giving an infinitely variable range of feeds up to 6in. Standard cams are timed to feed over 180 deg. of the press stroke cycle and starting to feed at any position within that cycle. Special cams can be supplied for use where this timing range is not covered.

The final setting of the feeding length is obtained by adjustment of a screw on the feeding carriage. As both feeding carriage and non-return mount are open fronted, they operate on the back edge of the material, and the adjustment for strip width is merely movement into correct position against this rear edge. A maximum of 6in width can be obtained with standard equipment and simple alterations enable handling of larger widths.

The forward feeding movement is effected by the rotation of the cam, and the return of the carriage is by compressed air acting as a compression return spring. Although to operate this feeder it is necessary to have a compressed air supply, no air is consumed, the line pressure being used only as a cushion.

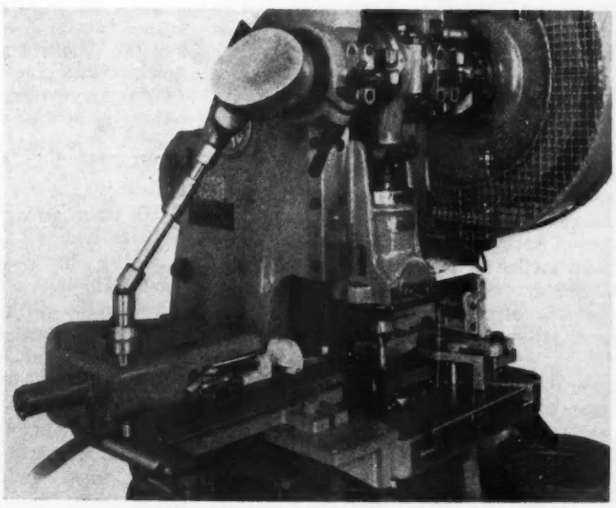


Fig. 8—Automatic strip feed unit for presses—Clark

LETTERS AND LITERATURE

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

RAILWAYS INTO ROADWAYS

SIR,—Noting that Mr. Brebner, in your issue dated May 9, proposed dealing with " fundamental errors of fact " on the part of Brigadier Lloyd I have been sufficiently interested to go through his letter, item by item, with some care.

Manpower strikes me as the most important single item and the one where the divergence between Lloyd and Brebner is greatest. Apparently Brebner agrees that transport is a non-productive public service in which it is important that the total number of people employed should be kept as small as possible ; his aim is to show that the number is already huge, so that British Railways' share (571,000) will not seem disproportionately large, which is what Lloyd has made it seem. The actual number should be readily ascertainable, but in fact the calculation depends so much on interpretation that precise agreement on the figure is unlikely ; one must weigh the evidence and decide for oneself which is nearer the mark, Lloyd with 2,000,000 or Brebner with 4,000,000. The latter reaches half-way to his figure at once by quoting the British Road Federation's number of 2,050,000 workers employed full time in road transport ; but he fails to mention that B.R.F. include in that figure the entire motor manufacturing industry, which is one of Britain's great productive exporting industries. If it is legitimate to include even the home sector of that industry then numerous firms over a wide field of industry, carrying out home railway contracts, must be added to British Railways' 571,000. Then B.R.F.'s 2,050,000 already includes 698,000 workers employed in private haulage (C licences) which seems ample, having regard to the part-time and owner-driver characteristic of much of that type of work : nevertheless, Brebner's second point is that C licence administrative personnel have been omitted : that is probably incapable of proof or disproof, and anyway seems too small a factor to be worth pursuing. Finally he taps the vast field of owner-drivership, and so manages to reach his figure of 4,000,000. But as we are discussing public service and not private service this addition must be disallowed. National manpower problems are helped, not hindered, and the national economy aided, by the things we do for ourselves.

Turning now to Lloyd's figure of " about 2,000,000 " I find that this is confirmed approximately by the British Productivity Council whose Review No. 24, published in May, 1956, states : " Transport .... employs directly 2,170,000 people or 9 per cent of the total working population .... this vast non-productive industry has the power to safeguard or shipwreck our national economy." Accordingly I for one have no difficulty in deciding that Lloyd is very much nearer the mark than Brebner on manpower, and probably has a livelier appreciation of its importance.

Brebner calls Lloyd to task, at some length too, for using the 1956 average freight trainload of 159 tons in an argument with another correspondent over a coal train. Using 1956 figures I find that B.R.'s freight comprises 60·7 per cent coal and coke, 23·8 per cent other minerals (in higher wagon loads than coal and coke) and only 15·5 per cent merchandise and livestock. Measured in ton-miles instead of tons the proportions are not very different, and plainly the average coal trainload cannot be much in excess of the overall average—159 tons. If Brebner chooses to counter an average figure with a maximum he only succeeds in drawing attention to how much lower even than the average the loading of many trains must be.

Then there is the matter of the tipper. Lloyd had not started on manpower at that stage, so Brebner's remarks appear to be irrelevant.

Brebner next attacks Lloyd's fascinating little calculation which, starting with roundly 600,000 men, 40,000 trains a day and 1,000,000 train-miles, proceeds inexorably to the conclusion that throughout the year the average train in traffic under load has the task of meeting hourly a sixty man-hour wages bill. Brebner's initial listing of some of the places where the men, other than the train crew of three, are to be found is irrelevant : wherever they are and whatever they are doing, the one and only source of their pay is from trains in motion under load, so Lloyd's calculation survives. Next, the term " roundly " is held not to cover the 600,000–551,000 bracket. That necessitates looking into Lloyd's 40,000 trains and 1,000,000 train-miles : the attack fails if they too are at or near the top of an 8 per cent bracket. They are, for plainly he has taken a seven-day week (forty-two hours average throughout the year) and B.R. claim to run 40,600 trains each weekday, which implies a daily average of 37,700 allowing for half traffic on Sundays. The daily average of laden train-miles is 932,756·1. So the sixty man-hour conclusion can be reached precisely, if so desired, instead of roundly. We have yet to discover any " fundamental errors of fact " ; there has so far only been a splitting of hairs.

In conclusion, Lloyd's mention of the National Union of Railwaymen's reference to the railway industry as the third most dangerous in the country brings down upon him and your readers the well publicised road casualty figures, which have nothing to do with this particular argument. It is more to the point that the average annual casualties to railway servants from 1951 to 1955 were 183 killed, 16,637 injured. Since the railways employ roundly one-fortieth of the working population some 7320 of Britain's breadwinners would be killed at work each year if all occupations were as dangerous. Fortunately they are not; the 1957 industrial fatalities numbered 2372.

I suggest that Mr. Brebner has signally failed to reveal anything in the way of a fundamental error or fallacy in Brigadier Lloyd's reasoning and calculations.

HERMANN BONDI

Reigate Heath, Surrey,
May 13, 1958.

SIR,—What is probably only part of the correspondence has come round to me. I think Mr. A. A. Osborne has left out one point : the state of the railways with which roads are compared. The railways in this country belong to the last century. Present proposals are to re-equip them, under the name of modernisation, with diesels and electrics, as suggested in the period 1925 to 1936. A third state of the railways is possible, using the engineering of the 1960s.

The protagonists of roads appear to use the first state : the improvement by changing to roads is large. The improvement possible, using the same amount of money, as third state railways is also large—and the only valid basis of comparison as the roads and lorries mentioned belong to the 1960s.

The only reason for changing to roads is if it is shown that anyone dealing with railways is always fifty years out of date. That they have been so is not enough. The Underground is relevant. Though basically a second state railway, it has several features which would help the main lines : no locomotives, motormen and signalmen not responsible for safety, pressure brakes and automatic couplings.

The beginnings of the next step, when control can identify the moving vehicles, have, rather surprisingly, appeared on the " 74 " buses. This, however, does not mean that the buses should take over the tubes.

H. COX

Teddington,
April 29, 1958.

SIR,—Before Brigadier Lloyd pursues his sniping at the long overdue Government policy of redressing the appalling wartime neglect of the railways, may I suggest that a little more time is devoted to research on the economics of applying the conversion theory into practice. If we just take commuter services from Liverpool Street as one example, the abolition of peak hour electric train services to and from suburban Essex would necessitate the provision of some 500 coaches or 300 double-decker buses per hour to carry the existing load. They would thus be at ten-second intervals between Liverpool Street and Shenfield, where the lines diverge. We will not dwell on the painful loading and unloading problems, or on the effect on this traffic flow of vehicles serving intermediate points attempting to leave or re-enter the ten-second interval " stream." But it is worth taking a glance at the economic employment of labour. The railways, no doubt, find difficulty in providing an economic working day for some two dozen motor-

men and two dozen guards who work the electric trains into Liverpool Street each peak hour, and have little or no return traffic to handle. I shudder to think of the appalling waste of labour if that four dozen men each hour should be converted into 1000 coach drivers and conductors, 90 per cent of whom would have no passengers for a return journey or, for that matter, for the rest of their working day.

I expect the banner will once again be raised of " ah—but we don't need signalmen, &c." As I see it, however, the prospect of coaches hurtling along at 60 m.p.h. between stops (if they are going to maintain the railway overall timings) and at ten-second intervals, with vehicles entering and leaving the stream at intermediate points, will either necessitate a more wonderful signalling system than the mind can visualise, or alternatively, the provision of a vast system of mortuaries and hospitals to deal with the casualties. In your Editorial, you state that Brigadier Lloyd's hypothesis has no defects sufficiently serious to put the idea out of court. To any serious student of transport, the practical difficulties, the bald economics and, lastly but most important, the serious moral issue of the carnage caused by road transport, are of such immense proportions that the idea could not, I agree, be thrown out of court. It could never even enter it !

E. R. SMITH

Dagenham,
May 3, 1958.

SIR,—Only having had the opportunity of studying a part of the correspondence relating to railway/road conversion, I wonder whether an intermediate scheme has been proffered by any of the contenders for and against.

A suggestion comes to mind which I came across many years ago which entailed retaining the existing main line railways and cutting out many of the intermediate stations, giving higher average train speeds and, with longer signalling blocks and fewer junctions, increased safety. Intermediate and branch stations could be served then by road transport utilising converted branch lines radiating from the chosen railway centres. Passenger traffic could be handled in omnibuses and goods in road/rail containers—a system which could be adopted for liquid and solid fuel transportation. Existing sidings would make adequate parking facilities for road transport and goods and passenger transhipment, both at main stations and discontinued branch stations. The problem of road safety would not be worsened by the opening of these new feeder roads as they would have a minimum of bottlenecks, intersections and extreme gradients, sources of irritation to many drivers, and thus of danger. The construction of " clover leaf " junctions at any convenient railway/road crossings would not be difficult and would assist safe entering and leaving the major road.

This, sir, is only a hypothesis which may be worthy of discussion—I will leave that to the experts.

K. B. FREEMAN

Burton-on-Trent,
April 30, 1958.

Book Reviews

Nuclear Reactor Theory. By J. J. SYRETT, B.A. *Nuclear Engineering* Monograph No. II. Temple Press, Ltd., Bowling Green Lane, London, E.C.1. Price 12s. 6d.

THIS is a very good summary of the theory of nuclear fission reactors, compressed skilfully, and with remarkably little loss of clarity, into a mere eighty pages. The author is a U.K.A.E.A. man, and naturally he dwells more particularly on the graphite-moderated, heterogeneous thermal reactor, but this is no fault at a time when such reactors are possibly the most successful in the field, at least for land-based power stations. He begins where too many writers on this subject fail to begin, with a definition of a reactor and a brief statement of its place in an electrical generating station. A few introductory pages on fission are followed by a swift narrowing down of interest to the thermal reactor.

Diffusion theory is admirably dealt with, considering the cramped conditions, and space is found to explain, at least qualitatively, its relation to transport theory. The author continues along a well-trodden route, but with a light step, to treat the slowing down of fast neutrons to thermal energy, and to describe some of the unrigorous but practical methods of calculation. While there is not room for much detail—and the audience to which the book is addressed will, in any case, not require it—the reader is made clearly aware of the various models adopted to make computation easier. The determination of critical size for bare cylindrical and spherical cores is reviewed, and reflectors are discussed. A chapter is devoted to lattice calculations, the author here following the methods of Guggenheim and Pryce. A chapter entitled " Reactor Operation at Power " is concerned mainly with reactivity, the causes and effects of variation in reactivity, poisoning, and the distribution of the energy from fission. The exposition ends with four brief pages on varieties of reactor and fuel cycles, and an attempt is made in this compass to compare other possible classes of reactor with that fuelled by natural uranium and moderated by graphite.

There are two appendices, one on the averaging of cross sections in a thermal reactor and the other on epithermal absorption in such a reactor. A bibliography is given, with references appropriate to each chapter. There is an attenuated index, and a useful list of the symbols used in the text appears at the beginning. The book is bound in thick paper covers.

Programming for an Automatic Digital Calculator. By K. H. V. BOOTH. Butterworth's Scientific Publications, 4 and 5 Bell Yard, London, W.C.2. Price 42s.

THIS little book forms a good first introduction to the art of programming two-address code machines. The book is written around the Birkbeck College, London University Computer, APEXC. This is a simple machine utilising only sixteen orders, nevertheless the principles apply to most two-address machines including the Hec range of computers of the British Tabulating Machine Company, Ltd. Whilst notations vary with different machines, it remains a tiresome feature for all programming that it is essential at the outset to master and memorise the particular order code, and this work is inevitably no exception. An international standard would be welcome. The programmes dealt with are such as are required for scientific rather than general business uses. Thus the programmes dealt with include the use of stop orders for checking the correctness of loops and subroutines, and programmes for decimal to binary conversion and the converse for input and output respectively, division, square root, nth root, polynomial expansions for sine and cosine, integration by Simpson's rule, normalising of numbers to bring them within a specific numerical range, frequency of occurrence analysis, sorting, matrix multiplication, simultaneous linear equation solving, fault finding and a floating decimal point arithmetic. The value of using pseudo-codes as an understandable shorthand for groups of orders to which the machines translate them is exceptionally well done and explained in relation to the floating decimal point arithmetic. Rather unexpectedly the book also includes a programme for translation of French to English. As no actual sample is given it is a little difficult to know just how useful this is, but at least it shows the manner in which such a task would be tackled.

The author is a highly experienced programmer, well aware of the difficulties and it would have been nice to have had a programme with most of the typical errors and how they are traced, given as a specific numerical example in the section on fault finding. The addition of tables of fractions in binary and decimal is, however, a useful contribution to this end, for which thanks are due. The real merit of this book is in showing the simplicity of programming given the mathematical problem in suitable terms, and that most persons can acquire the skill, without too much effort, to assemble a series of numbers and commands in suitable locations which will work as a programme even if it does not make the most of the machine speed, and that optimum programming is only worth while for often repeated ones anyway. The rather curt dismissal of automatic compilation of programme routines is only warranted by the further statement that these are not appropriate to teaching or the laboratory. The automatic mode of compilation is making great strides in U.S.A. amongst users of large scale computers and helps to make the limited number of trained mathematicians and programmers go round.

This is a good book by which to start programming while waiting for the ordered computer to arrive.

Man in Employment. By ALFRED B. BADGER, M.A., Ph.D. Arthur Barker, Ltd., 30, Museum Street, London, W.C.1. Price 25s.

THE object of this book is to set out the fundamental principles of industrial relations. So much has been written and said on this important subject in the post-war years that a certain amount of repetition becomes inevitable. Dr. Badger has dealt with just about all aspects of industrial relationships in this country ; he has presented his material in an interesting way, and in a way which indicates clearly the dependence of industrial success upon sound human relations.

Books Received

The British Shipbuilding Compendium. 1958 edition. The Shipping World, Ltd., Effingham House, 1, Arundel Street, London, W.C.2. Price 20s.

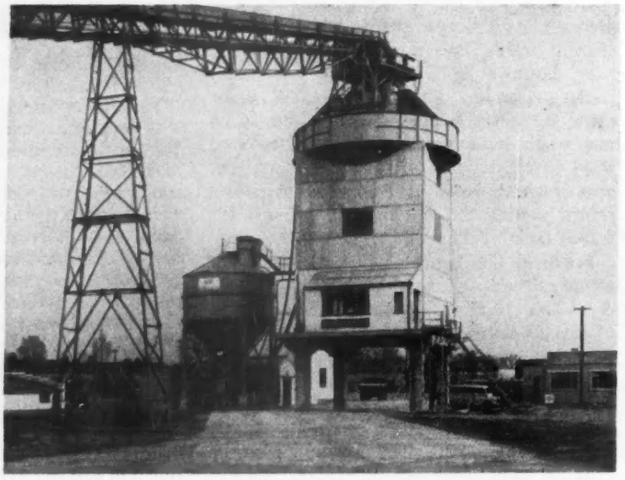
Electric Lifts. Fourth edition. By R. S. Phillips. Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 63s.

Van Nostrand's Scientific Encyclopedia. Third edition. D. Van Nostrand Company, Ltd., 358, Kensington High Street, London, W.14. Price 220s.

On Nuclear Energy, Its Potential for Peace-time Uses. By Donald J. Hughes. Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 30s.

Ready-Mixed Concrete Plant

The batching and mixing plant for ready-mixed concrete illustrated here has been built by Hall and Co., Ltd., at Mitcham, Surrey ; it is considered by the company to be the most modern of its kind in Europe, if not in the world. Its refinements include completely automatic control of batching and mixing, operated electronically from punched cards, and the pneumatic handling of cement. It is operated by two men, and has a nominal capacity of 300 cubic yards daily, which can be doubled by installing a second mixer.

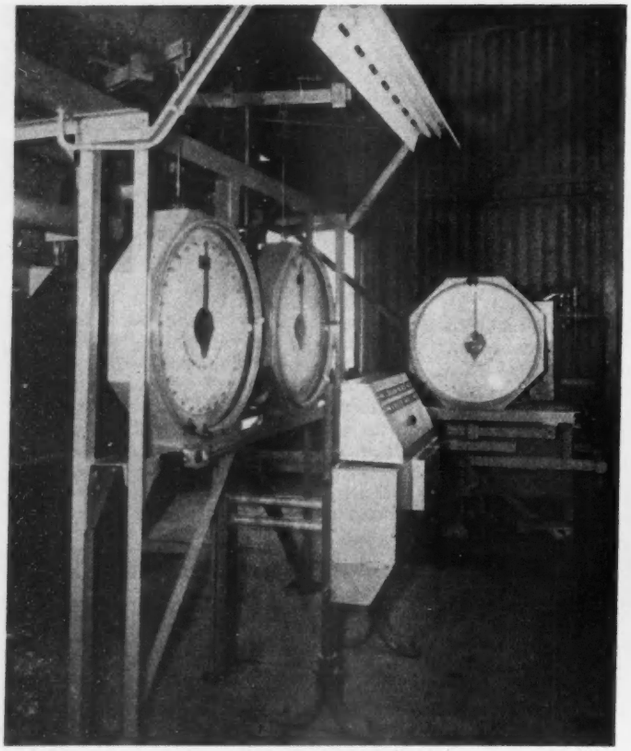


ON May 1, the Minister of Works, Mr. Hugh Molson, opened Hall and Co.'s new ready-mixed concrete plant at Mitcham. The plant is laid out to serve two 3-cubic-yard tilting-drum mixers, but only one mixer has been installed at present. Thus, for the usual mixing time of around two minutes, 3-cubic-yard batches can at present be turned out at a rate of 60 to 90 cubic yards in an hour. The main plant consists of a storage section, at the top, where 400 cubic yards of aggregate and 90 tons of cement may be stored. Beneath the multiple storage bin is the weighing section, and beneath that again, the mixer and control room. The mixer discharges into agitator trucks which drive under the plant.

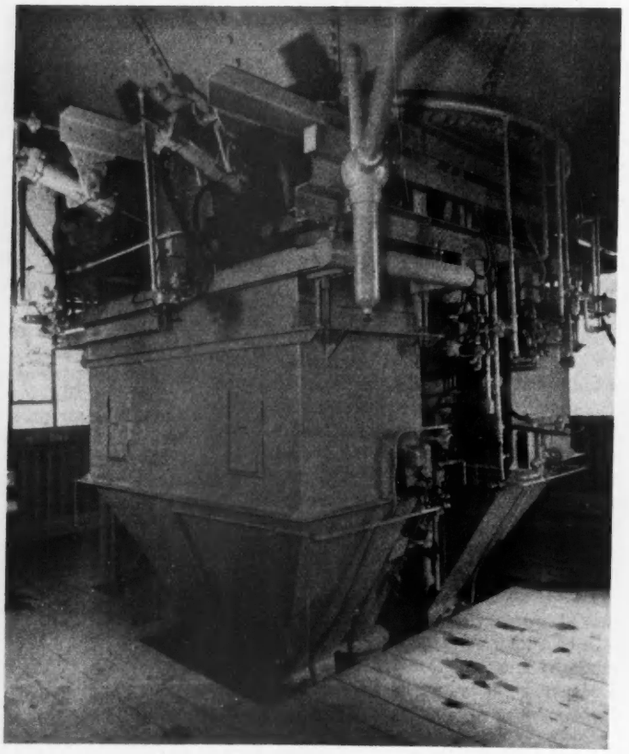
The storage bin, which can be seen at the top of the plant in the heading illustration, is 35ft in diameter. It has six aggregate compartments arranged round three central cement compartments. In normal operation of the plant four classes of aggregate are stocked—1½in, ¾in, ⅜in and sand, and two special aggregates such as "Terlite" lightweight aggregate and granite chippings. Similarly, the cement compartments will hold ordinary Portland cement, and, say, rapid hardening cement and a special product such as sulphate-resisting cement. Water is stored in a 7000-gallon tank, and pumped from thence to the water weigher. Control of the delivery of aggregates to the multiple storage bin is effected by an operator on the top floor of the plant.

Aggregates are delivered by lorry and tipped into one of four 12-cubic-yard feed hoppers. The feed hoppers serve the long inclined conveyor which leads up to the top of the plant. The radial gates of these hoppers are "Thrustor" operated, and are remotely controlled from the main plant, as we have already indicated. The main conveyor will deliver 150 tons of aggregates in an hour, and is powered by a 30 h.p. motor ; it terminates at a swivelling chute serving the six aggregate bins. A stockyard is being laid out next to the feed hoppers, where it is planned to stock 7000 cubic yards of aggregates.

Cement is delivered in bulk by tipping trucks and is discharged into two 15-ton receiving hoppers, which are each housed in a brick structure large enough to accommodate the entire vehicle. The rear of the truck is further enclosed by a hood which is sealed with rubber sheet and maintained below atmospheric pressure to suppress dust. Air slides in the base of each receiving hopper convey the cement in a fully fluid state to a pneumatic conveyor, whence it is delivered to the storage silo, which has a capacity of 220 tons, or to the cement bin at the top of



The weighing room. In the foreground are weighing dials for aggregate and cement, and in the background for water. The manually-operated control panel shown here may be used if the automatic control is not operative



Weighing plant. Note the pneumatic rams which control the entry of aggregates from the multiple storage bin above, and also the sampling doors on the aggregate weigh-bin. The central compartment is for cement

Cement storage silo. Note the two pneumatic conveyors beneath the silo and the flexible hoses through which cement passes to the main plant

the main plant. The storage silo is divided into two compartments, and cement can be reclaimed and elevated to the main plant through pneumatic conveyors, one of which serves each compartment. The storage silo is illustrated herewith ; the total capacity of the cement plant is 40 tons per hour.

Pneumatic Conveyors for Cement

The two pneumatic conveyors serving the storage hopper each consist of four principal elements, viz. a buffer hopper of 15 cubic feet capacity, an " activator," an automatic control system, and a compressor. The accompanying diagrams give a good idea of the functioning of these various elements, and show how a batch of cement is conveyed to the hopper of the main plant.

In elaboration of the diagrams the following points may be noted. The ram valve is five-way, including two exhaust ports, and is spring loaded to supply air to the top of the ram, thus holding the cone valve closed ; it is air operated by a pilot valve, which, in its turn, is operated by energising a solenoid. The filling cycle is thus timed by energising the solenoid for an interval—in this case about eight seconds is sufficient for the charge of 5 cwt of cement to flow in—controlled by the timer unit. When the charge of cement has been blown out of the activator (after one-half to one minute) the pressure-sensitive switch initiates the next cycle (if the silo has been emptied, pressure will not build up in the activator, and the plant will remain in the " blowing " position). During the filling cycle, air is blown through jets into the buffer hopper and the silo above to assist the flow, but is shut off when the cone valve is closed, and diverted to the activator. The two pneumatic conveyors at the receiving hoppers are similar, except for the activator, where no aeration pad is necessary, since the cement retains the fluidity imparted to it by the air slides. Each of the four pneumatic conveyors—which are known as " Auto-Airflow " units—is served by an independent air compressor. The normal operating pressure is 20 lb to 22 lb per square inch. If necessary, cement can be delivered into the silo by pressurised bulk cement vehicles.

Manual Control of Batching

It should be appreciated that operation of a plant of this kind is more complicated than would be the case with a similar plant on the site of a large dam, or some similar constructional project where large quantities of concrete are needed. There is a great deal of repetition on such sites ; perhaps only two or three different mixes might be called for throughout the course of the job. With ready-mixed concrete, however, every batch that is turned out might conceivably be different in specification from its predecessor, and capacity is controlled by factors such as the availability of the agitator trucks and the distances to their destinations.

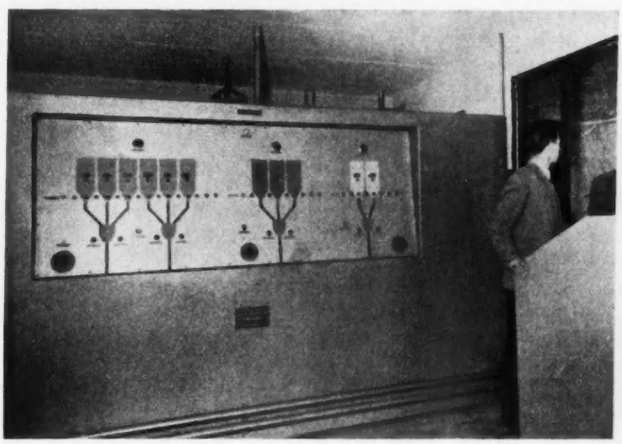
Thus the greatest degree of mechanisation is generally associated with concrete plants on constructional sites, and almost completely automatic control has been achieved on some of the larger ones, with a system analogous to, but more complicated than, the " manual " control at Mitcham, which may be used in an emergency, if the fully automatic control is not operative. Such control systems, however, presuppose a limited number of batch specifications preset in the controls. By way of comparison, we would refer to The Engineer of April 23, 1954, page 592, where the very large concrete station which is in use at the site of the Grande Dixence dam in Switzerland was described.

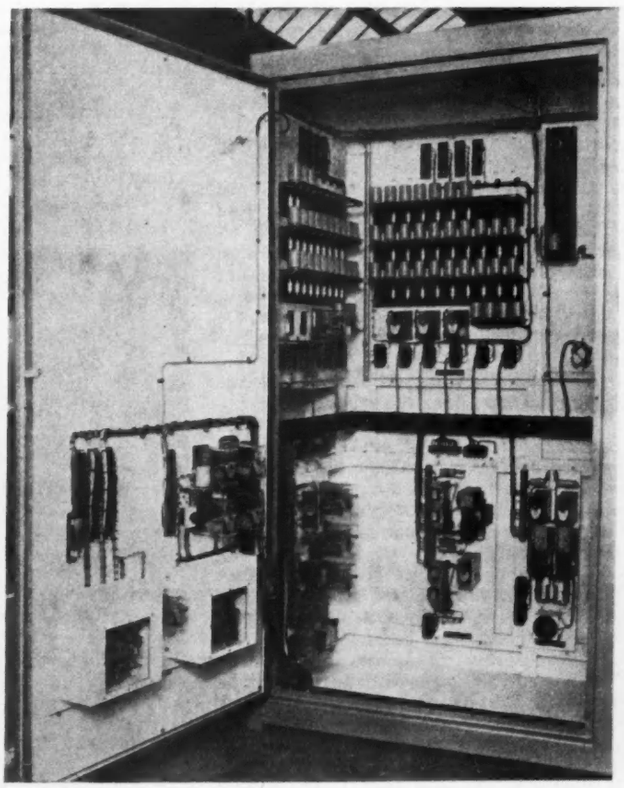
The illustration on page 740 shows the weighing dials and the manual control panel in the weighing room of the Mitcham plant. Aggregate from a particular bin is introduced by depressing a button on the panel, and keeping it depressed until the correct weight is registered on the dial. Each quantity in the batch must be measured in this way, the operator having carded instructions for the various mixes needed, so it can be seen that he could not, with accuracy, keep pace with the output of two concrete mixers using this form of control.

Before passing on to the punched card control system, the illustration of the batching plant itself should be referred to. This follows generally accepted practice for such plant, and has two bins for weighing aggregates, where up to six weights are measured cumulatively, up to a total of 8000 lb ; between them is the cement weigher which has a capacity of 2800 lb. Water is weighed separately, in a weigher of 1500 lb capacity. Cumulative weighing of three and two materials respectively for the cement and water weighing is possible.

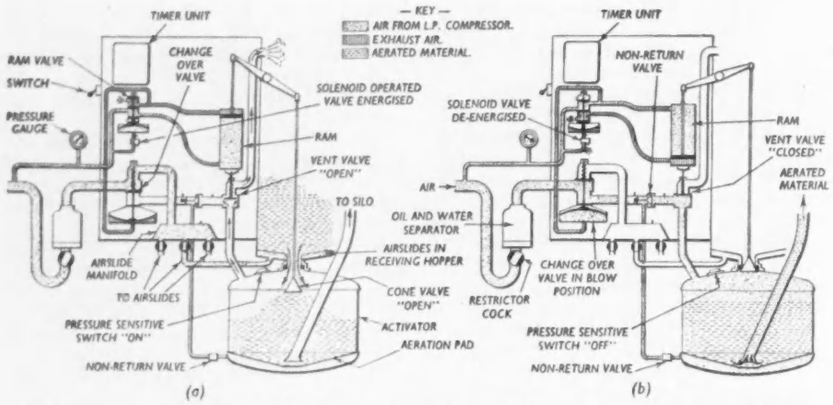
Automatic Control of Batching and Mixing

The illustration on this page shows the control room of the plant. The various figures of weights needed to specify a mix are coded on a punched card which is fed into a Powers-Samas cabinet on the left of the control room, and not shown in the illustration. The entire sequence of operations up to discharging the mixer can then be initiated





(Left) Control room. The dispatch clerk is at the mixer control panel, observing the mixer. The batching control panel is shown centrally. Not shown, to the left, is the cabinet for the punched cards. (Right) Rear view of one of the three sections of the batching control panel. Much of the equipment is of typical Post Office design



(*a*) Filling the activator. (*b*) Blowing. The charge in the activator is aerated at the bottom and displaced through the flexible hose by the air admitted at the top. If the plant has been inactive for a time, aeration of the buffer hopper and the storage silo above it can be carried out as a preliminary stage, prior to filling the activator.

Operation of pneumatic cement conveyor

by pressing a button ; an emergency control can stop the sequence at any stage, or it can be set to repeat the same sequence continuously.

The large panel in the centre of the illustration—the " Select-o-Weigh " proportioner—governs the batching of materials. On the left the six aggregate compartments are represented, from which weights are measured cumulatively, centrally the cement weighing (again with three cumulative weighings possible) and on the right the water weighing, with a subdivision to permit the measurement of an additive. The dial in the centre of the panel at the bottom is a setting for the moisture content of the sand ; the percentage of water in the sand is measured in the laboratory, and compensation made for it over the range 2 to 12 per cent by setting this dial (the weight of sand is also entered twice on the punched card).

Weights are measured in the proportioner by methods which are commonly used in this class of control engineering and the equipment is not novel. The reading on each weighing dial is signalled back to the proportioner as a resistance which is balanced against a resistance corresponding to the instruction on the punched card when the correct weight is reached, and then the feed of material is stopped. The assembly of all such elements into the complete control system is, however, complex. Indications of progress in weighing successive materials, and of the materials which are selected, are given on the panel by the successive illumination of signal lights, the final light showing that weighing is complete and the batch is being discharged into the mixer.

Protection by interlocks is complete at this stage. For instance, the discharge of a weighed batch is not possible except into an empty mixer ; the closure of all gates is checked ; and a tare-weight check ensures that a batch has been completely discharged to the mixer.

The desk on the right displays the mixer panel with a timing dial controlling mixing time, and push button controls. Normally all these controls are automatic, except the discharge of concrete into the agitator truck. The truck driver signals when he is in position by a green light on the desk, and the dispatch clerk then presses the discharge button, but as a double check he can watch the wet mix hopper (into which the mixer is emptied) discharging. Discharge to the agitator truck is the only operation in the sequence which is not protected by interlocks. The panel is laid out for the ultimate installation of two mixers.

Concrete Laboratory

A concrete laboratory is built alongside the plant, and all the tests normally associated with quality-control in concrete work are carried out here. One of the most frequent checks is for the moisture content of the sand. Samples can be taken from doors in the weigh-hoppers or at preceding stages in the plant. Another task carried out in this laboratory is the design of mixes, and hence the preparation of the information punched on to the cards of the control system. One of the great advantages of this system is that any error subsequent to punching the cards is eliminated ; inaccuracy rather than actual error in weighing is also eliminated. The error of the control system itself is stated to be about 0·1 per cent.

Concrete can be supplied from the plant to more or less any specification, but the method favoured is, apparently, for the customer to specify a figure for crushing strength at a given age. Clearly the plant meets the standards of control which is demanded by contemporary concrete technology, and any mix within the limits of the materials available to it can be produced.

The general layout of the plant was conceived by Hall and Co., Ltd. and Blaw Knox, Ltd. The aggregate stocking out hoppers and conveyors were designed and fabricated by Hall and Co., Ltd. ; Blaw Knox, Ltd. designed, supplied and erected the ready mixed plant, bulk cement storage and pneumatic handling equipment. The " Select-O-Weigh " automatic proportioning panel was supplied by Henry Simon, Ltd., and was adapted, in co-operation with Blaw Knox's engineering design department, to meet the particular requirements of ready-mixed plant operation.

Mechanical Handling Exhibition

No. II—(*Concluded from page* 706, *May* 9)

THE Mechanical Handling Exhibition at Earls Court closes tomorrow and we continue below our notes on some of the recently developed equipment being shown.

An interesting demonstration of the application of electronics to the control of a selective conveyor system is that upon the stand of the Manufacturers' Equipment Company, Ltd., Sutton Road, Hull. On this stand electronic equipment developed by E.M.I. Electronics, Ltd., is fitted to a " Rapistan " conveyor set-up representing a main storage flow rack bank delivering to a conveyor system feeding boxes into a number of subsidiary conveyors through selective stations. The general set-up can be seen in Fig. 7.

Two methods of releasing packages from the " Rapistan " flow racks are demonstrated, first, a manually operated keyboard of nine push button switches is used. Any number of these switches may be pushed simultaneously, but the actual release of the individual packages is at periods of five seconds. This delay period between delivery of packages allows for solenoid operating times and also prevents choking the conveyor immediately in front of the flow racks. The second

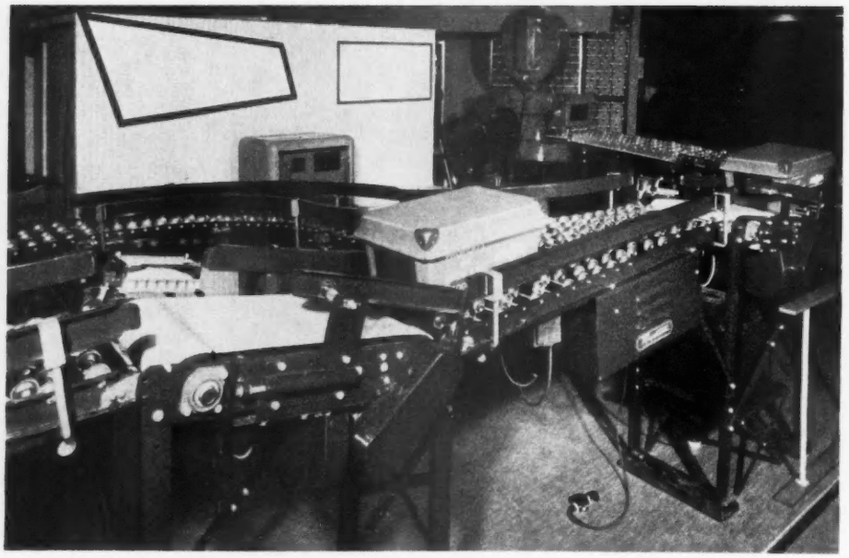


Fig. 7—Selective roller conveyor system with parcel selection station in left foreground—Manufacturers Equipment

method of operation is automatic, and delivers packages in sequence, from each flow rack, again with the necessary time delay between each delivery.

The packages then pass in turn through an automatic weighing station. This weighing system uses a digitally coded disc, which converts the movement of the scale pointer into positional information which can be used for remote display, automatic point recording or for control purposes. A sequence movement operates to deliver each package after weighing to the conveyor system. Recognition of the packages for direction to the subsidiary conveyors is effected by a coded route selection device which reads a particular code in the form of a binary coded label attached to the packages travelling along a belt conveyor section inset in the main gravity roller system. The labels, supplied by Gordon and Gotch, Ltd., are printed with strips of black and white, and are so positioned on the packages that they are always " scanned " by the selector heads. Just before each spur curve, or ploughing-off point, is a selector head, on the side of the power belt conveyor. The selector heads are identical in form and consist of a number of transistor photo-cells and light sources. The photo-cells are so arranged that the selection mechanism for diverting a parcel from the main flow is operated only when one particular code arrangement on the label is recognised.

A feed conveyor demonstrated by C. J. R. Fyson and Son, Soham, Cambs, is fitted with

Fig. 8—Rotating scalping cylinder fitted on a belt conveyor—Fyson

the rotating scalping device shown in Fig. 8. This scalping device is designed to replace the conventional scalping screen or usual hand picking of large pieces from a flow of material. It comprises a rotating fabricated cylinder from which there project a series of rigid fingers arranged in the form of a helix. The cylinder is suspended from the main conveyor structure by a frame through which its height can be adjusted relatively to the belt. In operation, as the material on the belt passes below the rotating cylinder, the fingers contact and throw off to the side any lumps larger than the size predetermined by the height setting of the scalper.

This firm is also showing its " Alligator " equipment for reloading bulk materials from a heap or stockpile direct into the input hopper of a conveyor. It comprises an endless chain fitted with specially designed flights and carried on two slewing wheels. The wheels, which are slewed to a parallel position for travelling, are set at an angle when the machine is put to work. With this angular setting of the wheels the reloader moves into the stockpile through an arc about a fixed point at the discharge end, which automatically remains in the same position. Movement may be to the left or to the right; the width of cut available is 5ft, 7ft 6in or 10ft.

The small driving gear for belt conveyors shown in Fig. 9 is one of the three sizes on

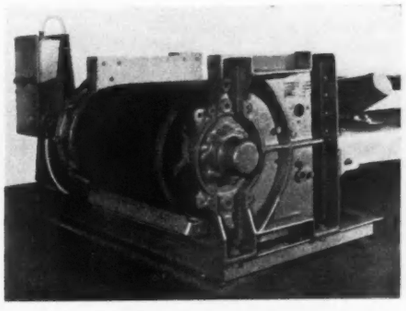


Fig. 9—Small driving gear for belt conveyors—Mavor and Coulson

the stand of Mavor and Coulson, Ltd., of Glasgow. This " Size 25 " drive gear, with a 6 h.p. motor, gives a belt speed of 270ft per minute. Each of the three driving gears shown can be driven by any type of motor or engine through vee-ropes, which absorb the shocks of sudden heavy loads. The two larger sizes of these self-contained and weatherproof drives are widely used on field conveyors as well as in permanent sites. The smallest unit is exhibited at work driving a belt conveyor which runs on a new form of sectional belt conveyor.

The idlers shown for supporting and guiding belts include a cushion idler for receiving points and a steering idler for reversible conveyors.

Supplementing the wide selection of conveyors and elevators are the exhibits of the belt manufacturers, who have kept abreast of modern requirements, and the increasing demands for strength, flexibility and resistance to abrasion and wear to meet the improvements in equipment design.

A large proportion of the mechanical handling plant to be seen uses hydraulic equipment for power transmission or controlling in one form or another, and amongst the specialist manufacturers of the equipment at Earls Court is Keelavite Rotary Pumps and Motors, Ltd., of Allesley, Coventry. The representative selection of equipment on this firm's stand includes a recently introduced " GP " gear pump range covering displacements from 16·5 g.p.m. at 1000 r.p.m., with maximum speeds of 3000 r.p.m. These pumps are available for clockwise and anti-clockwise rotation, with front, rear or double shafts. The maximum pressure ranges from 2000 lb per square inch for the smaller units to 1000 lb per square inch for the largest. The new pumps supplement the existing range of units covering displacements from 4 to 9 g.p.m. at 1000 r.p.m. Supplementing the display of pumps is a range of the firm's control valves, including a new ¼in directional valve, and hydraulic cylinders.

A working demonstration of an infinitely-variable-speed and reversible hydraulic rotary drive forms the principal exhibit of Dowty Hydraulic Units, Ltd., of Cheltenham. The system is composed entirely of standard hydraulic pumps, which are available with outputs from 0·6 to 50 g.p.m., motors made for duties up to 30 h.p., and control equipment. A new hydraulic hand pump, with a peak working pressure of 2500 lb per square inch, shown has a displacement of 0·82 cubic inch per double stroke of the handle, and its reservoir capacity is 6 pints.

The hydraulic valves made by the firm are for pressures up to 2500 lb per square inch and flows up to 50 g.p.m. with a choice of control by open or closed centre pistons and spring or detent control of the actuating lever.

Electrical Drives

An interesting development in crane drives demonstrated by Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester, 17, is that of a twin-motor hoist-control system applied to a 7½-ton travelling crane. This system uses two identical induction motors, each of approximately 65 per cent of the horsepower required, both permanently geared to the hoist motion and running at the same speed. These two motors are used in conjunction to give the following characteristics :—hoisting and lowering creep speeds varying little with load, slow light hook speeds, electric braking when lowering, a lively hook on lowering notches, i.e. adequate drive-down torques so that the hook and load are made to reach a steady speed quickly (in contract to d.c. potentiometer lowering). In its latest form the driver's control position consists of two control pedestals and a separate chair to permit driving from either a seated or standing position. This is found to be of advantage when spotting awkwardly situated loads. It can, however, only be used with contactor-controlled equipment.

The control levers are arranged to give " sympathetic " movement. Those on the right-hand pedestal control " Hoisting and Lowering " and cross travel " In and Out," with a forward and backwards movement. The control lever on the left-hand pedestal operates in a transverse direction to give long-travel control of " Left and Right." Short-stroke, minimum-effort controllers are used with three notches only in either direction, giving slow speed on two notches followed by automatic acceleration to full speed on the third notch. The hydraulic foot brake equipment for the " long-travel " motion is now a separate item and is mounted under the cab with an accessible inspection cover in the cab floor. The operating pedal is between the control pedestals to be easily accessible to a standing or seated driver.

The cabin is normally panelled with armour plate glass and sliding windows on three sides to give unobstructed vision.

A neat application of the well-known principle of using eddy-current couplings to get variable-speed output from a constant-speed source of power is being shown by the Vaughan Crane Company, Ltd. This company has collaborated with the British Thomson-Houston Company, Ltd., Rugby, in developing an equipment known as the " Varislip," which is a combined a.c. motor and eddy-current coupling arranged in a single casing to occupy the minimum space.*

* The "Varislip" motor was described and illustrated in our issue of April 11, 1958, page 550.

Originally, this unit was developed for use in a variable-speed hoist block. More recently the device has been applied to the hoist and travel motions of overhead travelling cranes, where very fine control of speed and position are required. Control is very flexible, speed variation being obtained by varying the excitation current of the eddy-current coupling.

In Fig. 10 we show " Varislip " units

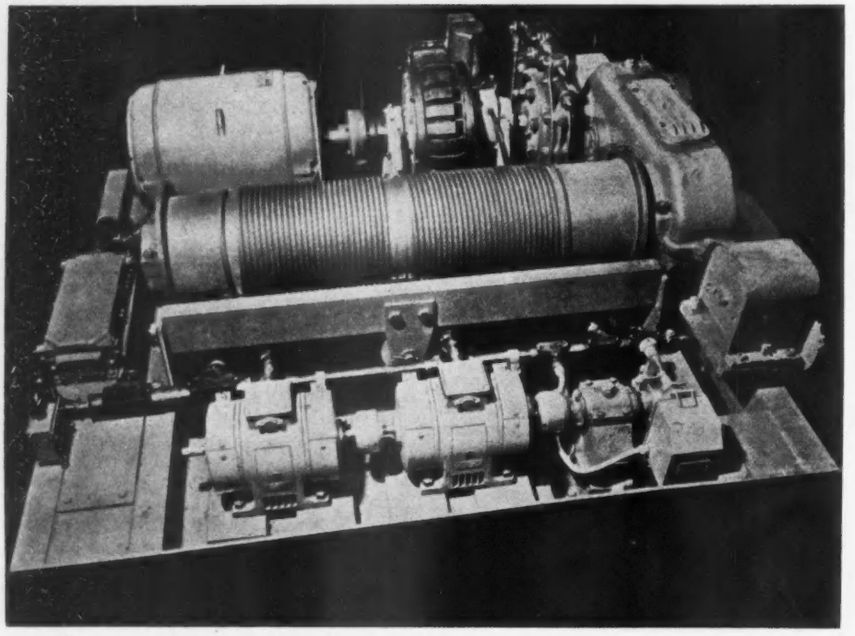


Fig. 10—" Varislip " units consisting of motor and variable speed coupling combined in one casing—B.T H.

installed on a 5-ton " Vestax " series II crab.

The well-known principles of braking squirrel-cage motors either by using capacitors or by injecting direct current into the windings have been combined in an equipment demonstrated by the British Thomson-Houston Company, Ltd. This scheme provides rapid braking of rotating machinery with low power consumption and without requiring extra space or maintenance. It is applicable equally well to machines controlled manually or automatically.

The high-pressure hydraulic pumps for operational pressures up to 2500 lb per square inch displayed by the Plessey Company, Ltd., of Ilford, Essex, are made in four basic sizes and, by arrangements of the gears and bearings, eighteen graded variations of output from 0·27 to 42 g.p.m. are available. Five different pipe positions for inlet and outlet ports of these pumps can be selected by the use of straight and elbow port adaptors.

An interesting working model on the stand of Mitchell Engineering, Ltd., shows a proposed mechanical method of overhauling large tankers without the use of elaborate dry-docking facilities. It consists of a slipway equipped with a series of flange-wheel carriages fitted with keel blocks, which runs down from the shore on to a thick concrete runway beneath the water.

A tanker coming into such a " dock " for a refit is brought on to the slipway guided by a series of buoys or siting poles located in the water to form a plainly visible " run-in " on to the slipway. The tanker arrives at high tide and is anchored to the correct buoy, and as the tide recedes the ship slowly lowers on to the keel blocks below. When completely bedded down, it is hauled up the slipway on the carriages. The motive power is supplied by electric motors in pits well above high water level. It is pointed out that the use of a slipway of this kind is restricted to tankers of up to 50,000 tons displacement.

Another model displayed by this firm shows a design for a multi-storey mechanical car park it has developed for congested cities. This " Parcar," as it is known, is a structure divided into two parts separated by a lift section. Each lift can handle up to twelve cars at one hoist. The lift operator merely presses a button for each car to be electrically positioned on the car platform, which then takes them up for automatic discharge at the allocated floor.

A total of 576 vehicles could be housed on a twelve-floor structure, each floor of which could carry forty-eight cars. It is stated to be possible to deal with twenty-four incoming cars a minute for any reasonable period. The model exhibited shows the working of a twenty-storey mechanical car park, which has two hoists, each capable of carrying ten cars, giving space for a total of about 800 cars.

Amongst the interesting demonstrations being given of new equipment there is a new electronic control system for powered trolleys or industrial trucks developed by E.M.I. Electronics, Ltd., which enables a driver to be dispensed with. For this system there is laid over the desired route a wire which can be either taped to the surface for temporary routes or laid under the flooring for permanent routes. Alternating current of a specified frequency is passed through this wire. Two sensing coils fixed to the front of the trolley pick up signal currents from the magnetic field, thus set up, and keep the trolley on the desired path. There is no physical contact between the wire and the guiding device.

Immediately the control current is switched on, the trolley brakes are automatically released and the trolley sets off on its unaided journey along the wire. A stop signal can be flashed from the control panel to apply automatically the brakes, and safety devices instantly stop the trolley if the route is obstructed, or in the event of the failure of the control system.

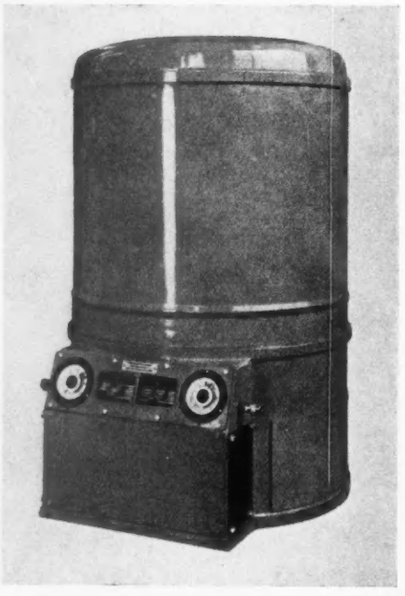
As long as the trolley remains on its true course, the current magnetically induced into the two pick-up coils is equal and the steering control is not operated. Immediately it tends to wander, however, the current induced becomes unbalanced and amplified signals operate a servo motor coupled to the steering mechanism. The motor immediately restores the trolley to its intended course.

Vertical High-Frequency Motor-Alternator Set

A NEW form of vertical-spindle, high-frequency motor-alternator set, of medium rating (75kW to 300kW), for induction heating and melting applications at a frequency of 8·7 kc/s has been introduced by the British Thomson-Houston Company, Ltd., Rugby. It is on show at the Mechanical Handling Exhibition at Earl's Court, London.

Being arranged for vertical operation, the new set occupies far less space than a normal horizontal machine of the same rating. It is water-cooled and is designed to be very quiet in operation.

The first set to be manufactured has an output



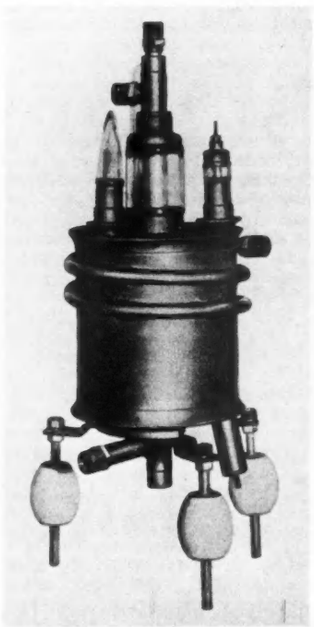
A new design of vertical water-cooled motor-alternator set with an output of 75kW at 8·7 kc/s

of 75kW, 8·7 kc/s. It consists of a heteropolar inductor alternator and a squirrel-cage induction motor mounted vertically above it. The frame and the shaft are mounted on the bottom end shield and the set is supported on four resilient mountings. The set is totally enclosed inside sheet metal covers, which can easily be removed, and is cooled by two water coolers, one being placed in the alternator stator core and the other wound spirally round the motor frame.

A similar B.T.H. vertical set of a higher rating is also made, and other sets will shortly be available at 3 kc/s and 8·7 kc/s, with approximately double the output of the present machine. Under suitable conditions, these high-frequency alternators may be operated in parallel to supply higher powers than can be generated by a single unit.

Single-Anode Rectifier

RAILWAY electrification in Great Britain on the 25kV, 50 c/s, single-phase system has created a need for rectifiers of much smaller size for a given output than conventional mercury-arc rectifiers, and suitable for installation in vehicles subject to vibration and impact shocks. To meet these conditions, The General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2, has developed a new equipment, the "Com-Pak" mercury-arc rectifier. Rectifiers of this kind are to be installed in the locomotives and multiple-unit equipments which the company is supplying for a.c. electrification on British Railways.



The "Com-Pak" single-anode, mercury-arc rectifier, "C7-Mk 1"

The "Com-Pak" rectifier, as illustrated here, is a single-anode cylinder with liquid cooling. It is being made in two sizes, the "C7–Mk1," rated to give a continuous output of 120A at up to 1250V, and the "C9–Mk1" unit of twice that capacity. Overload capacity is 125 per cent of rated current for two hours in accordance with B.S.1 698, Class II. By giving special attention to cathode spot stability and cooling, it has been possible to achieve the outputs required within the limited dimensions of these rectifiers. Furthermore, the arc path is shorter, the voltage drop lower, and, consequently, the efficiency higher than in conventional designs of mercury-arc rectifier. The anchoring of the cathode spot has also simplified the fitting of additional devices to restrict swilling of the mercury caused by vibration and shock, and has enabled certain other forms of baffle to be omitted, making practicable a smaller anode/cathode separation than usual. The lower arc drop also reduces cooling requirements.

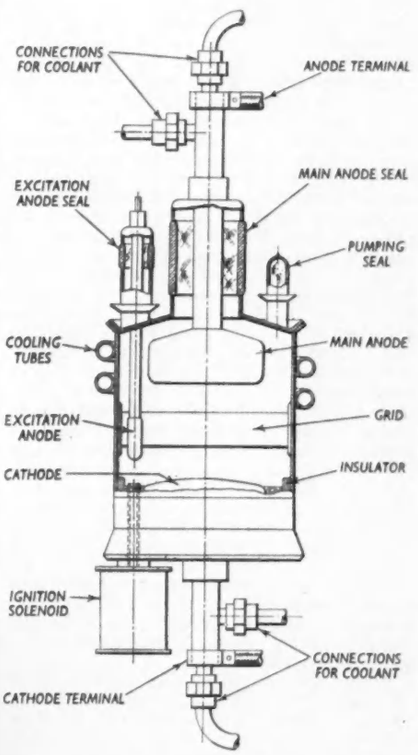
A "squirt" igniter is used: a plunger is pulled down by energising a solenoid external to the rectifier, which forces a jet of mercury from a small nozzle against the excitation anode and completes a circuit to establish a direct-current arc between the excitation anode and the cathode. This continuous excitation current is used to actuate a contactor which breaks the ignition solenoid circuit and allows the plunger to rise again to the top of the ignition tube. In the event of failure of the excitation current, the contactor recloses and re-energises the ignition solenoid. Excitation current varies between 3A and 6A, depending on the supply voltage. The excitation circuit for each rectifier cylinder is fed from a separate source and is self-contained.

In electric locomotives and motor coaches the rectifiers will be connected to give full-wave rectification. Eight cylinders, supplying the four 200 h.p. motors of a motor coach, together with the cooling apparatus and water pump, will occupy a cubicle measuring about 6ft 4in long, 2ft 9in high and 2ft 6in deep. Ignition circuit equipment will be installed separately in another case. An installation for a 3300 h.p. locomotive might be divided between two cases, each about 6ft long, 4ft 6in high and 2ft 6in deep, containing all the apparatus except the coolant pump, which would be mounted separately.

We learn that tests of the rectifiers have been carried out in collaboration with British Railways. For this purpose, two bogie parcel vans were made available. One housed a 130kW diesel-alternator set, which provided the source of power, and the other contained the rectifier equipment, transformer and loading resistance. The rectifier equipment included four units (one acting as a spare) assembled in a framework comparable in size with that which would be used for undercarriage mounting on multiple-unit rolling stock. The transformer permitted two conditions of d.c. loading, namely, 130A at 1000V, or 260A at 500V, giving a current loading on each rectifier of 43A and 86A respectively.

"Com-Pak" rectifier equipment installed in railway van for tests under service conditions

Tests included repeated shunting at walking pace against fixed buffers, giving rise to particularly violent shocks on the rectifiers. This was followed by runs at speeds up to 45 m.p.h., which included emergency stops and accelerations. The vans formed part of a close-coupled passenger coach train, and trial runs were made with the test vans at the front of the train and repeated with these vans at the rear. Similar tests were made with the vans attached to loose-coupled freight trains, when the shocks experienced were more severe than those likely to occur in normal service. Finally, the test vans were coupled close to the locomotive of a high-speed passenger train, when speeds up to 90 m.p.h. were recorded.



Simplified drawing of the "Com-Pak" single-anode rectifier

Throughout these tests, the performance of the equipment was satisfactory, only minor modifications to the mounting of the rectifiers being needed to give improved flexibility.

During the test a Hallade recorder was used by officials of British Railways to provide a continuous recording of vertical, horizontal and canting movements as well as speed, acceleration and deceleration. From this information a rocking platform has been constructed for use at the works. With this equipment service conditions are closely simulated and rectifiers have now been tested under continuous full-load and cyclic loading conditions, such as would occur in normal traction service.

"Com-Pak" rectifiers operating from a single-phase system have also been used for supplying power to traction motors on test at the company's Witton Works, when the opportunity was again taken to study their behaviour when supplying cyclic loads. Investigations are also being made on the performance of these rectifiers on industrial loads, and a 350kW, 440V, six-phase equipment has been installed for this purpose in the power house of the company's Witton Works.

SHORTER REPORTS

Scientific and Industrial Research

THE report of the Department of Scientific and Industrial Research for the year ended December 31, 1957, was published at the end of last week. It is the first report of the new executive council set up under the D.S.I.R. Act, 1956. This report therefore differs in some respects from its predecessors in that, instead of describing the Department's activities in detail, it reviews the main problems with which the council is concerned and the way in which they are being tackled.

The report opens with a review of the changes which have occurred in industrial and scientific research since the Department was established forty-two years ago. It goes on to discuss the effect of these changes on the Department's fundamental tasks. Consideration is given, for example, to the part the D.S.I.R. should take in the conduct of pure research. The executive council says that the universities are, and will continue to be, the main centres of pure research, though a proportion of pure research, it is added, should be carried out wherever applied research is done on any scale. The report records the Council's belief that its expenditure on pure research must rise considerably; in 1956–57 there were 115 grants, totalling £836,000 in value, recommended for special research projects in science and technology, compared with forty-seven grants, totalling £400,000 in the preceding year. Another matter considered in the report is the part that D.S.I.R. stations should play in research of direct application to industry. The scope of this work is at present being reviewed. Meanwhile, the Council says, there is a large and growing field of activity in which the Government has a direct interest and a special responsibility and in which, therefore, the research work required is appropriate to a national research establishment. But in order to undertake new responsibilities it is necessary to shed some of the existing load. As part of the Council's review mentioned above, *ad hoc* committees have been set up to examine the work and functions of the National Physical Laboratory, the Chemical Research Laboratory and the Mechanical Engineering Research Laboratory.

Finally, the Council expresses doubt as to the adequacy of the resources for all that it is charged to do. The report points out that in those industries which do not benefit directly from research done primarily for defence purposes, the value of production approaches £10,000 million a year; by contrast, the D.S.I.R. is spending less than £10,000,000 a year for all its activities.

"Tube-in-Strip" for Solar Energy Water Heaters

ONE of the interesting applications now being developed for "Tube-in-Strip," a new heat exchange material, developed by Imperial Chemical Industries, Ltd., Millbank, London, S.W.1, is its use in solar energy water heaters.

The principle of using the energy produced by solar radiation to heat water for domestic purposes is already well established in countries where climatic conditions are suitable and where other sources of energy are limited and costly. The simplest kind of equipment consists of a heating element in the form of a flat copper sheet directly exposed to the sun's rays, the heat absorbed being transferred, by means of water circulating through copper tubes in close contact with the plate, to a hot water storage tank.

A high efficiency is ensured by "lagging" the back of the heating element with insulating material and by covering the surface exposed to the sun with clear glass, which, acting as a "non-return valve," transmits the short-wave radiation from the sun, but prevents reradiation of long-wave radiation from the heating element; it also stops heat losses due to circulating air currents.

Solar energy absorbers function at their most efficient and economic level in countries where a high proportion of clear sunshine can be relied on all the year round—for example, in regions lying between about 40 deg. North and 40 deg. South of the Equator.

"Tube-in-Strip," a single piece of copper (or aluminium) providing a combination of parallel tubes and sheet, is made by conventional strip-manufacturing techniques, except that during casting rods of a special inert material are introduced into the rolling slab. In the rolling process, these rods elongate uniformly, leaving parallel narrow slits running from one end of the strip to the other. These slits are then inflated by pneumatic or hydraulic means to form finished tubeways. No brazing, bonding or adhesive is required, as the tubes form an integral part of the sheet. It provides high heat transfer efficiency and exceptional corrosion resistance, and facilitates the completion of water-tight soldered connections.

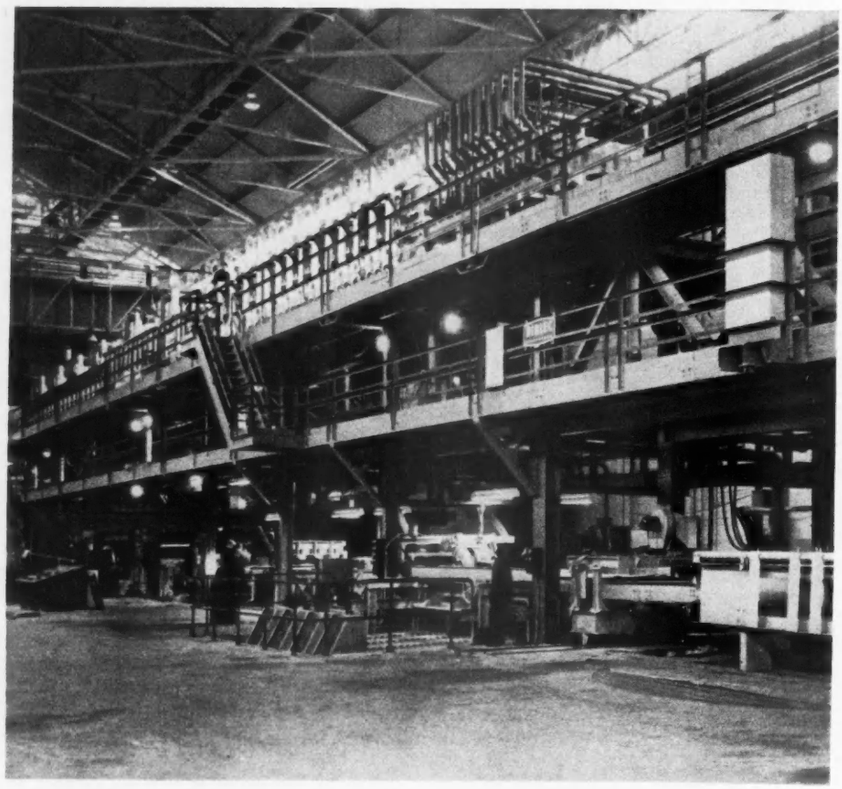
Continuous Galvanising Line

A CONTINUOUS galvanising line designed by Birlec, Ltd., Erdington, Birmingham, and installed at the Ebbw Vale works of Richard Thomas and Baldwins, Ltd., is designed to produce 10 tons of either galvanised sheet or coil an hour. The photograph we reproduce gives an impression of the installation which is 700ft long and 30ft high. It takes strip up to 48in wide, which is carried through the plant by roller conveyor at up to 250ft per minute. In one continuous operation the strip is cleaned, heat-treated, pickled, coated, sheared to size and inspected, under the control and supervision of only six men.

In the sequence of operations the strip is cleaned in passing through a gas-fired flame-heated furnace after which its temperature is further raised to 1550 deg. Fah. in the heating section of the reducing furnace by gas-fired radiant tubes. In the following electrically heated section where the strip is maintained at a constant temperature surface oxide is reduced, and annealing takes place. Entering a controlled cooling section it passes into the galvanising bath at 950–1100 deg. Fah. depending on the requirements of the bath, which is self-maintained at approximately 850 deg. Fah. by the temperature of the strip passing through. Electric heating elements are provided for initial melting of the bath, and for temperature boosting during topping up.

The strip emerges with a coating which has an adherence sufficient to withstand drawing and forming operations up to the limit of the steel base. Throughout the line a protective atmosphere of dissociated ammonia is supplied to all chambers by the Birlec ammonia cracking plant.

The total electrical rating is approximately 1000kW plus 50kW for each of the two ammonia dissociators. For the gas-fired sections, coke-oven gas with a gross calorific value of 500 B.Th.U per cubic foot is used, the flame heater taking 18,000 cubic feet per hour and the reducing furnace 21,000 cubic feet per hour.



Continuous galvanising installation for the treatment of up to 10 tons of 48in wide strip an hour

Industrial and Labour Notes

The Coal Industry

The first report of the House of Commons' Select Committee on Nationalised Industries, published last Friday, deals with the coal industry. Since it was appointed last November, the committee has met fifteen times and, as stated in the report, has "received more information about the National Coal Board than the House has ever yet had on the workings of a nationalised industry." The report deals with investment, manpower and management, coal prices and stocks, large and small coal, exports and uneconomic pits.

In some general comments, the committee expresses the view that the early and substantial failure of the 1949 *Plan for Coal* is a warning for the future, and adds the opinion that the 1956 plan *Investing in Coal* is already in jeopardy. The report goes on to point out that the National Coal Board is understandably reluctant to alter its broad and flexible plan even when essential factors (such as output per man year) are not developing along the lines estimated, but the committee considers it to be essential that the Board "should be in a position to react quickly to changes in circumstances and in demand." A case where quicker action might have saved later trouble, the report observes, is the problem of large and small coal. Many of the present difficulties in that problem might have been averted if there had been an earlier and larger effort on finding other uses for small coal and on methods of increasing the proportion of large coal, and an earlier introduction of the sharper differential in prices.

About prices, the report comments that although there are several sound and strong arguments for the proposition that the price of coal is too low relative to its true costs, the committee believes that any further increase in the price of small coal might tip the balance in favour of oil as against coal for a number of uses. The committee has therefore noted with approval the greater emphasis now being given to the National Coal Board to reducing costs, as against the absolute priority it gave earlier to the volume of production. One of the committee's recommendations is that the Ministry of Power should be able to make a greater financial check on the Board's investment schemes than it does at present. To this end, it is urged, the Board should present to the Ministry each year full details of those major schemes which it expects will be least profitable.

Employment and Unemployment

In its latest report on the employment situation in Great Britain, the Ministry of Labour says that during March the number of people engaged in civil work fell by 23,000 to 23,022,000 (15,274,000 men and 7,748,000 women). The biggest decline occurred in the manufacturing industries in which at the end of March 9,214,000 were employed, compared with 9,284,000 at the beginning of the year. In the engineering, metal goods and precision instruments group, the number employed declined in March by 15,000 making the total 2,819,000. It should be noted, however, that that figure was 2000 above the total returned at the end of March, 1957.

The report indicates that, in the week ended March 29, the number of operatives in manufacturing establishments who were on short time was 119,000 which was 16,000 more than in the preceding month. In the four weeks ended April 9, the employment exchanges filled 128,000 vacancies, the number of vacancies notified but remaining unfilled being 218,000. That was 1000 more than in March. The number of registered unemployed on April 14 was 443,699, compared with 433,071 registered on March 17.

Safety in Industry

Last week-end the industrial safety division of the Royal Society for the Prevention of Accidents held its annual conference at Scarborough. The theme of the conference was "Works Tidiness." The opening address at the conference was by Dr. W. H. Garrett who urged that the greatest need at the present time was to arouse the national conscience in safety matters. One of the major factors in safe factory operation, he said, was "better housekeeping." Housekeeping started in the original layout of buildings in order to give good light and ventilation and easy access to all parts of the plant; it continued with such matters as clean and unobstructed floors and proper storage facilities. After the right start, Dr. Garrett went on, it was necessary to maintain the standards of cleanliness, which could only be done by sound training of the operatives, by regular and systematic inspection by people who were genuinely concerned in the well-being of the workers, and by those means with the efficient operation of the factory. There were, Dr. Garrett added, two kinds of inspection; the one which aimed at the maintenance of a high standard and the one which aimed at the minimum that would "get by" the factory inspector. From a safety angle, he commented, the second was useless. Indeed, it was positively harmful, as it convinced the employees that on safety matters management was insincere and paying lip service only.

Working Conditions on the Railways

Last Friday, the House of Commons debated a private member's motion, proposed by Mr. F. Noel-Baker, which called on the Government "to make further provision for the health, welfare and safety of railway and allied workers, in the light of the recommendations of the Gowers committee; and to ensure that their interests, as well as those of railway users are fully considered while modernisation is taking place." Mr. Noel-Baker said that he did not in the least underestimate the tremendous difficulties with which the British Transport Commission was contending, some of them because of legacies from the past—the old decrepit installations, workshops, offices and running sheds inherited from the old railway companies—and some of them because of difficulties put in the way because of constant Government interference.

There were, of course, he added, the wider difficulties resulting from the Government's economic policy. With or without legislation, Mr. Noel-Baker continued, and with the best will in the world, it could not be expected that all the black spots of the railway system could be put right overnight. But to have a "framework providing minimum standards" would be a positive help to the British Transport Commission, as it had been to private employers and to the National Coal Board. It would also have a very considerable psychological as well as practical effect on the men working in the industry.

The Joint Parliamentary Secretary to the Ministry of Transport, Mr. G. R. Nugent, spoke for the Government. At the outset, he made it clear that there was no change in Government policy as to the principle of introducing legislation in implementation of the Gowers report. He accepted that there was a great deal to be done on the railways, and the only point of difference was on the question when legislation should be introduced. After seeing a good deal of the work on the railways during the last eighteen months, and seeing the modernisation going forward, Mr. Nugent said he was certain the British Transport Commission fully realised the importance not only of mechanical modernisation but modernisation in management and personnel relationships.

Railway Wages

The British Transport Commission's latest wage proposal for railway staff was put to representatives of the three railway unions on Tuesday by Sir Brian Robertson. The Commission offered a 3 per cent wage increase to date from June 30 and suggested that a comprehensive examination of the wages structure should be made. This offer was put forward following discussions, at the end of last week, between the Minister of Labour, Mr. Iain Macleod, the chairman and members of the British Transport Commission and representatives of the three railway unions. An agreed statement which was issued after Sir Brian's meeting with the union representatives on Tuesday said that the discussions took place "in the light of the measures to strengthen the finances of the Commission." A letter from the Minister of Transport to Sir Brian Robertson, the text of which was published on Wednesday, said that "the extent and timing" of any increase must depend on the view the Commission takes of its ability to pay having regard to the improvement in its financial position resulting from the measures which had been decided upon in the recent discussions between the Government, the Commission and the unions.

Export Credits Guarantee Department

The Export Credits Guarantee Department's provisional balance on its commercial account for the financial year 1957–58 was about £4,800,000, resulting in a provisional cumulative balance on trading since 1930 of some £12,900,000. This balance, it is stated, represents the "underwriting reserve" in respect of liabilities of about £452 million. It has now been almost restored to the position at the end of the financial year 1951–52 when it stood at £13,000,000—to be reduced one year later to £1,300,000 because of heavy claims in respect of Brazilian transfer delays, and subsequently to a deficit of some £3,500,000. Claims payments on commercial account last year, at £4,675,000 (provisional), were less than in 1956–57 (£5,411,000). Recoveries, at £4,864,000 (provisional) were, however, also lower than in the previous year (£5,397,000). Provisional figures for business underwritten for the encouragement of exports "in the national interest" show a surplus over the year of about £1,000,000, resulting in a cumulative balance of £2,200,000 at the end of the financial year.

German Industries Fair, Hanover

No. III—(*Continued from page* 712, *May* 9)

Salzgitter Maschinen A.G.

On the large stand of Salzgitter Maschinen A.G. in the open air section of the Fair there was shown working a new type of loading and conveying equipment specially designed for the economic turning over of heaped bulk materials such as ore, coal, coke and limestone. It consists essentially of two machines, a rotary disc loader and an intermediate conveyor belt. These are illustrated herewith. With such machinery bulk material may be handled with a daily turnover of 2000 tons. The rotary disc loader illustrated below has an average capacity with continuous loading of 125 cubic metres per hour. The maximum grain size of the material to be handled can be approximately 30cm to 40cm. The loading shovel has a clean-up range of 2500mm. The machine has a total length of 14·7m and the length of the delivery belt is 8m. This belt has a slewing range of 180 deg. with a radius of 8m. It can discharge to a height of 1m to 5m and has working or road speeds of 5m to 42m per minute. The capacity of the driving motor is 60kW and the total weight about 20 tons.

The intermediate conveyor belt, which may consist of several interconnected belts, though only one was demonstrated at the Fair, has a length of 20m, and a width of 650mm. The hopper width is 1·5m and it is mounted on a central chassis with eight double sets of rubber tyred wheels, giving a slewing range of 360 deg.; the elevator can discharge up to a height of 8·5m and it has a maximum handling capacity of 500 tons per hour. The belt conveyor speed is 1·3m per second and the driving motor has a power of 22kW. There is also an auxiliary drive for road travel and steering, slewing and elevation which is powered by a VW oil engine of 25 h.p. The total weight of the conveyor belt and chassis is about 10 tons. With this arrangement it is claimed that dumped material can be turned over or re-dumped without having to lay rails or make room for cranes.

One other interesting development shown alongside was a new boring head for oil drilling, &c., which has been developed under patent licence from Russia. In this new design the turbine driven boring tool is the only rotating part of the boring arrangement. The turbine and gearing have rubber sealing rings which prevent stresses passing to the stationary boring tube. This means that a lighter and thinner tube can be used and results have shown increases in output from four up to ten times the output of normal boring plants. The turbines

Intermediate conveyor belt—Salzgitter Maschinen A.G.

and gearing have been worked out in conjunction with Haniel and Lueg G.m.b.H. of Düsseldorf. The set of this new type of boring gear was completed in July, 1957, and went into service at home and abroad in the second half of last year. A number of different kinds of boring heads were also shown.

Rotary disc loader and intermediate conveyor belt—Salzgitter Maschinen A.G.

Koch and Sterzel A.G.

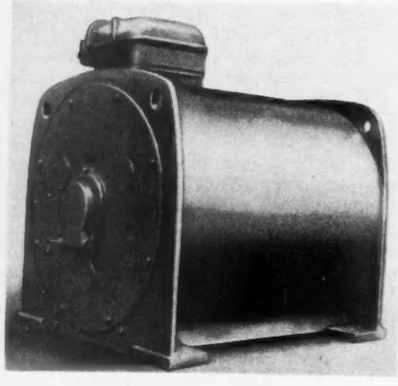
Koch and Sterzel Aktiengesellschaft, Essen, showed a number of current measuring transformers, covering the range 100A to 5000A. These are made with porcelain or cast resin insulation, the latter making possible a great reduction in size and weight as well as having a higher electro-dynamical short-circuit strength. An improved surface of the resin is obtained by means of a patented process. Our illustration

Laboratory standard current transformer, for 3000A to 20,000A—Koch and Sterzel

shows a current transformer made by this firm as a laboratory standard for the Physikalisch-Technische Bundesanstalt, Berlin. This has a range of 3000A to 20,000A. By means of the heavy terminal bars which can be clamped to the round terminals in a variety of ways, the primary connections can be varied. The connecting is done by bolting on four plates with vee-grooves, thus forming eight line contacts per terminal. Each line contact can therefore carry 2500A. Another exhibit was a fully automatic rectifier for an electric filter, which keeps the operating voltage to a value just below the flash-over voltage.

A.E.G. Allgemeine Elektricitats-Gesellschaft

This company, which this year celebrates its seventy-fifth anniversary, has, like other leading electrical manufacturers, set up a permanent stand in the new Hall 13. Many of the larger exhibits could only be shown in the form of models. This applies to a gas-turbine-driven blower for a blast-furnace plant. The blower absorbs some 5400kW and compresses 147,500 cubic metres of free air per hour, which it compresses to 2·5 atmospheres absolute. The overall size of the installation, which is for a Belgian blast-furnace plant, measures 30m by 15m by 8m high. About 35 cubic metres of cooling water are required



Water-cooled 500kW, 6kV synchronous motor—A.E.G.

per hour. Another model showed a light water reactor for a nominal output of 340MW (125MVA at generator terminals). This design, which is still under study, operates with steam of 40 atmospheres absolute and at a temperature of 249 deg. Cent., generating some 595 tons of steam per hour. The power station is stated to have an efficiency of 28 per cent.

For situations where the air is particularly dust-laden or corrosive, use is made of water-cooled motors. This year, A.E.G. showed the model "AWM 500/2" watercooled synchronous motor, with an output of 500kW, suitable for 6000 volt mains. Only the stator is watercooled; the rotor is cooled by air which subsequently passes over the internal wall of the water jacket. Water consumption is 2·4 to 3·3 cubic metres per hour. The motor runs very quietly, its noise amounting to only 80 phon.

Other items included a magnetic time relay for 600W a.c. or 6300VA a.c. with stepless adjustment between 0·3 and 2·5 seconds. The time response is practically independent of the supply voltage and room temperature within a range of ±10 per cent. A recent development is the high-voltage, hot-cathode, mercury vapour thyratron model "ASG 5009" for peak voltages and currents of 15kV and 12A, respectively. Agent: Welmec Corporation, Ltd., 147, Strand, London, W.C.2.

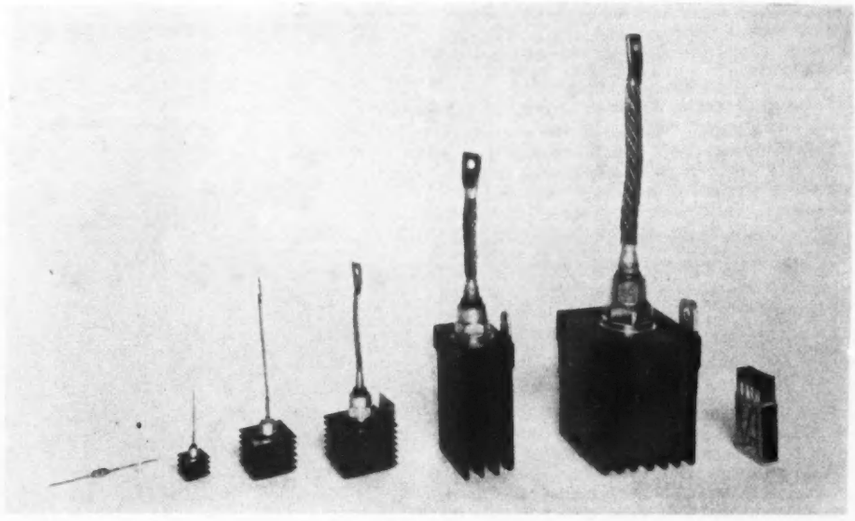
Siemens and Halske A.G. and Siemens-Schuckertwerke A.G.

Recent investigations are stated to have shown that about 70 per cent of office work can be "automated" as compared with 25 per cent of undustrial processes. A large proportion of office automation will be connected with developments in telecommunications engineering. In some applications, e.g. teleprinters and telephones, a preliminary stage has been reached, but automation is already possible with such apparatus as dial telephones, automatic tariff printers, and punched tape printers (for repeating the same text).

In its exhibition in Hall 13, Siemens and Halske A.G. showed a very full range of such equipment. New developments include the "Model 100" teleprinter a completely redesigned machine

"Model 100" teleprinter capable of writing over 600 characters per minute, here shown with punched tape transmitter—Siemens and Halske A.G.

capable of transmitting 600 characters per minute. The machine measures 282mm by 391mm by 542mm and weighs only 24 kg. It works according to the start-stop method and is remarkably quiet in its operation. This has been achieved by good dynamic design and the use of rubber buffers and a closed case. Of great assistance is the fact that the paper does not move during the printing but only during line shifting. This makes it easy to read the text while it is being typed out. Lubrication is required only after every 1000 hours (even this embodies a safety factor of 3), and maintenance is rendered extremely simple by the fact that the machine is built up from a number of easily interchangeable sub-assemblies. A punched tape receiver and transmitter can be supplied as extras, as can equipment for wireless and duplex operation, and for two-colour, tabulating and form-writing work. The machine is suitable for the tropics and its ability to interpret correctly distorted signals is greater than required by international standards.

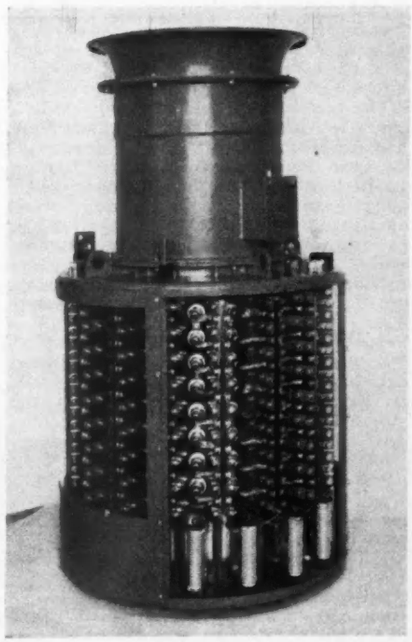


Silicon power rectifier elements with copper cooling fins for currents of 0·5A to 200A—Siemens and Halske A.G

In the manufacture of electric light bulbs and radio valves it is important to use only heater wires without flaws. Such flaws may have their origin in inclusions in the original material, which show up after drawing as minute longitudinal or transverse cracks. Local overheating or fracture during coiling, as well as uneven electron emission, is the result. A simple arrangement for the continuous testing of fine wires was exhibited by Siemens and Halske. It consists of an electrically driven re-winding mechanism which winds the wire under test over two guides, one of which is coupled to an ultrasonic generator, and the other to a receiver head. Ultrasonic impulses are sent through the wire and made visible on the screen of a cathode-ray tube Where cracks occur, the amplitude of the received signal is diminished and the machine can be set to stop when below a certain minimum amplitude, so that the faulty wire can be cut out.

Large amounts of electric energy are used for plating and in the chemical industry for the manufacture of chlorine, sodium and potassium hydroxide, hydrogen and other substances. In West Germany's aluminium industry, some 3 milliard kWh were used last year to produce 160,000 tons of aluminium. It is clear that with such a large consumption even small improvements in efficiency are of great financial importance, for an improvement of even only 1 per cent in the aluminium industry alone represents an annual saving of approximately DM.1,000,000. The total installed d.c. capacity in the German Federal Republic has been estimated to be about 4000MW.

Since current is generated and transmitted mostly in the form of three-phase a.c., means of subsequent rectification have to be provided. The most recent development in this field has been that of the silicon rectifier. A range of silicon rectifier elements has been put on the market by Siemens-Schuckertwerke A.G., Berlin and Erlangen. These are made from specially grown single crystals of up to 25mm diameter which have originally impurities of not more than 1 in 10^9. The crystals are cut into slices by diamond saws. The underside of the slice is covered with a metal foil and made *p*-conducting (removal of electrons), while the top, except for the edge, is made *n*-conducting (addition of electrons). It is at the boundary of the *n*-zone that the rectifier action takes place. Because of the high voltages across the boundary —each cell can support a maximum inverse voltage of 600V—the surface has to be kept scrupulously clean and it is therefore protected by enclosing the rectifier in a capsule filled with protective gas. The size of the silicon disc ranges from 3 to 150 square millimetres and it is connected to a lead of about the same cross-section. In order to improve cooling, the capsule is screwed into a finned copper block. Losses are small and for a size of 150 square millimetres amount to only about 230W. Since such an element can transmit 50kW, its efficiency is of the order of 99·6 per cent (compared with about 92 per cent for selenium rectifiers). The operating temperature is also high (up to 140 deg. Cent.) so that the power required for air cooling is kept low.



Silicon rectifier set for 800kW, 750V, for a shunting locomotive—Siemens-Schuckert

The first Siemens silicon rectifiers were put into service three years ago. A year later rectifiers up to 800kW and 1200A were commissioned. An 800V, 1600A rectifier for a two-frequency express locomotive is being tested. In the chemical industry, rectifiers up to 6000A, 450V are in service, and three installations for 100,000A and 150V, 300V and 750V respectively, are under construction.

French Electrical Industry

Over seventy French manufacturers of electrical equipment and machinery showed their products on a total stand area of 2500 square metres. Equipment shown out of doors in-

cluded transformers and switchgear for 400kV for the French super-grid, including a three-pole air-blast circuit breaker with a capacity of 12,000MVA.

Deutsche Wanson Warmetechnik G.m.b.H.

The Deutsche Wanson Warmetechnik G.m.b.H., Wiesbaden, Mainzer Strasse 110, a subsidiary of E. T. S. Wanson S.A., Brussels, showed examples of its large "Thermobloc" air heaters. These units, which are self-contained, supply warm air to workshops, churches, or other large buildings, either directly or through ducting. These units can be oil-fired, or arranged for gas or coal-firing. They are built in sizes up to 675,000kcal/hour (2,700,000 B.Th.U. per hour). Agent: Wanson Company, Ltd., 7, Elstree Way, Borehamwood, Herts.

Metrawatt A.G.

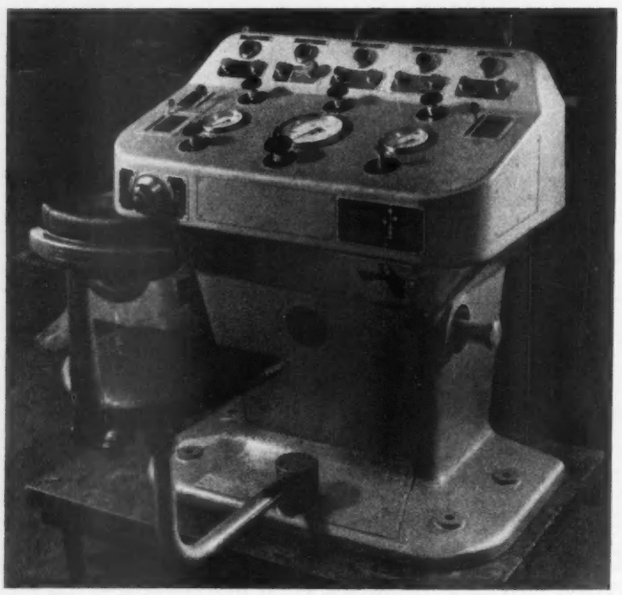
For the locating of wires embedded in walls, Metrawatt A.G., Nuremburg, has developed a pocket-size instrument equipped with transistors. This instrument also allows the detection of breaks and short-circuits. The action is either inductive or capacitative, depending on whether alternating current is flowing in the conductor, or whether it merely carries an a.c. voltage. When the instrument is placed over the spot where the wiring lies embedded, a maximum or minimum reading is shown. The amplified a.c. voltage can also be used to supply a set of earphones. Sensitivity is stated to be such that a single wire carrying 1A can be detected from 1m away, while twin wires spaced 8mm apart and carrying the same current are detectable from 15cm. Voltages against earth of 220V can be detected from 10cm away.

Gotthold Haffner Maschinenfabrik

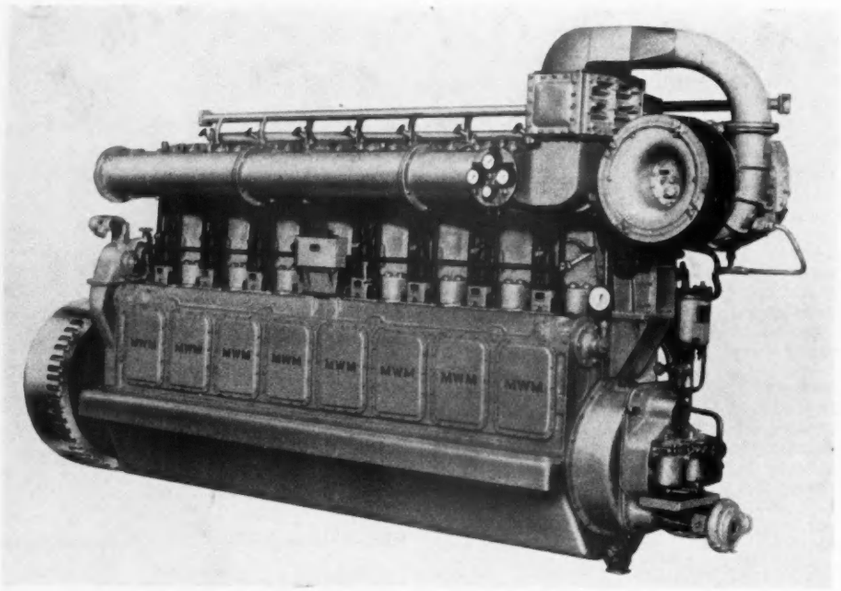
As usual, a full selection of woodworking and power tools was shown. In particular, high-speed tools for cutting and routing wood and plastics were well represented. As an example may be mentioned the model "RF30" portable router, by Gotthold Haffner Maschinenfabrik, Oetisheim/Württemberg (C. D. Monninger, Ltd., St. Anna Works, Overbury Road, London, N.15). It has a speed of 20,000 r.p.m. and is equipped with tungsten carbide cutters. Various cutters, stops and attachments can be used for trimming plastic sheets at right angles or forming bevelled edges. Grooves for attaching plastic or aluminium edges can also be milled into the edge of plywood or other table tops and shelves.

Towler Brothers (Patents), Ltd.

On the stand of Towler Brothers (Patents), Ltd., Electraulic Works, Rodley, near Leeds, was shown an extensive selection from this company's range of designs relating to the hydraulic operation and control of presses and other machine tools. One of our illustrations shows the control desk for an 800-ton forging press. The main control lever is adjacent to the seated operator's right hand. By selecting various positions of the lever, fast, slow and medium forging speeds are obtained, also similar return speeds. It should also be noted that for rapid planishing, the lever may be held down and the load delivered by the press will be proportional to the weight applied to the lever by the press operator. The control knob at the side of the press is for the adjustment of pressure reversal of the main ram. On the left is a dial for controlling the amount of daylight opening of the press, which may be varied whilst the main ram is in motion. The buttons to the back of the panel are the motor starter buttons, whilst the three stop cocks in the front of these are isolating gauges, so that once pressure has been set the gauges may be isolated in order to preserve them against the rapid fluctuation in pressure. The left-hand top lever gives the three positions for the three different return speeds, while the lower lever is an emergency valve, whereby all oil can be evacuated quickly to an underground dump tank, and at the same time all pumps are closed down as a safeguard against leakage or fire. The lever on the right hand of the desk is for movement of the press anvil. Towards the front edge of the desk, at the right-hand side, is the air pressure adjustment for the prefill tank, and in the centre the stop cock, which connects the return cylinder directly to exhaust, allowing the main ram to be inched down for tool setting, without using the rest of the system. The knob to the left is the isolation cock for changing over to automatic planishing. In this system low-pressure oil is used in order to open or close primary valves, thus allowing main pump pressure to be admitted to the cylinder, or prevented from passing the main cylinder and allowed to pass to exhaust at approximately zero pressure.



Control desk for 800-ton hydraulic forging press—Towler Brothers (Patents), Ltd.



Eight-cylinder stationary diesel engine developing 1200 h.p. at 375 r.p.m.—MWM

Also shown were examples of a range of packaged units which are now being put on the market. These comprise a 50-gallon oil tank, with oil sight glasses and air filter. The attached desk is fitted with a control valve, pressure gauge and gauge isolating cock, as well as variable pressure relief and unloading valve. Any one of a number of pumps can be used, ranging 3·1 to 18·8 cubic inches per second and 9000 lb to 3750 lb per square inch for high-pressure and up to 100 cubic inches per second for low-pressure pumps. The motor horsepower varies between 4 h.p. and 25 h.p.

Motoren-Werke Mannheim A.G.

A wide application of the constant pressure pre-combustion chamber first publicly shown at Hanover in 1956, was the keynote of the display of Motoren-Werke Mannheim A.G. (MWM), Mannheim, which this year celebrates its seventy-fifth anniversary. The new series is the KD/AKD 412, water-cooled and air-cooled engines developed from the series KD/AKD 112; the incorporation of the pre-combustion chamber is stated to increase the engine output by 25 per cent. The firm's large diesel engines for marine and stationary use have had their power increased by improvements in the exhaust turbocharging, and a twelve- and sixteen-cylinder version of the "RHS 518" series has been developed giving up to 680 h.p. at 1500 r.p.m. One of our illustrations shows the largest design built, the model "HTRH 348A," which develops 1200 h.p. at 375 r.p.m.

E.M.I. Electronics, Ltd.

Among new equipment shown by E.M.I. Electronics, Ltd., Hayes, Middlesex, was an analogue computer especially designed for industrial organisations, both large and small, which are faced with complex design or production problems. Known as "EMIAC II," the computer can be adapted to a vast range of specific applications. The basic operation, which can be likened to a slide rule, can solve in a matter of hours, problems that would normally take a team of specialists weeks or months of calculations on paper.

Visitors were able to see what is at present the smallest version of this computer engaged in solving current design problems. Problems of both production and design can be investigated with great saving in time, cost, labour and materials. Considerable care has been taken to simplify the computer's operation so that operators need no specialised knowledge of electronics.

(*To be continued*)

American Nuclear Engineering Conference

BY OUR AMERICAN EDITOR

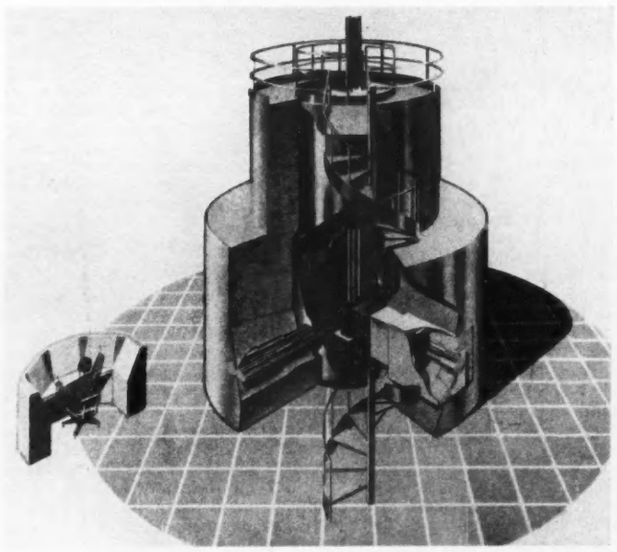
No. IV—(*Continued from page 715, May 9*)

The fourth Nuclear Engineering and Science Conference was held at the International Amphitheatre in Chicago, Illinois, from March 17 to 21, in conjunction with the 1958 "Atomfair" exhibition. The conference was organised under the sponsorship of the American Nuclear Society in co-operation with twenty-eight other American and Canadian engineering institutions. The exhibition was sponsored by the Atomic Industrial Forum and presented a comprehensive picture of the current state of development in the application of atomic energy in American industry.

ACF Industries

A DUAL-PURPOSE nuclear reactor for educational and training uses and certain research applications was announced at the Atomfair by the Nuclear Products-Erco division of ACF Industries, Incorporated, of New York. The pool type unit, which is illustrated below, will operate at power levels up to 10kW and was designed for use by universities and engineering colleges. The 10kW reactor is prefabricated, except for the concrete shielding, and can be installed in existing buildings. Excavation is required only for the footings of the poured concrete shielding. The exterior installed measurements of the reactor are 18ft 3in high and 20ft in diameter. The pool tank is 7ft in diameter. Its operation requires only water and electricity supply.

The standard equipment includes a thermal column, two beam tubes and one through tube. Additional beam tubes can be added if required. A circular walk-way 15ft in diameter around the top of the tank permits viewing of the internal workings of the reactor. The complete unit, including shielding and instrumentation, is expected to cost between 180,000 and 185,000 dollars. Although the reactor was designed primarily to facilitate training it has all the operating characteristics of higher powered reactors and offers sufficient power to perform limited research operations. It also offers the safety, flexibility and operating advantages of the open-pool concept.

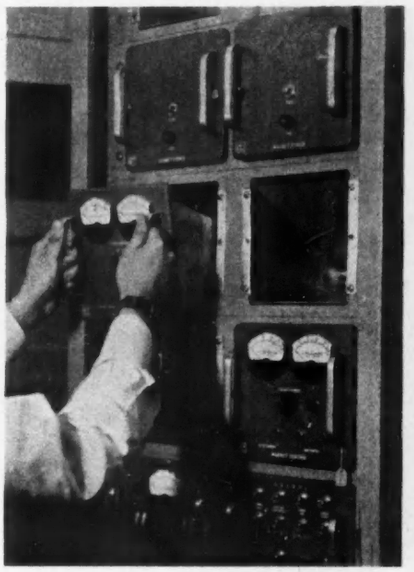


10kW research and training reactor of the open pool design by ACF Industries

The 10kW reactor is the second of a new line of low-powered, pool type reactors which the firm has developed. Its first training reactor, a prefabricated, portable pool type unit with power up to 10W, was announced last November. At present the company has in various manufacturing stages reactors for the Massachusetts Institute of Technology, the Italian National Committee for Nuclear Research, the Reactor Centre of the Netherlands, the Atomic Energy Company of Sweden and the U.S. Air Force at the Wright–Patterson Air Force base. The company recently was selected to design a gas-cooled natural uranium power reactor under a contract awarded to Kaiser Engineers by the U.S. Atomic Energy Commission. The Atomic Energy Commission also announced in March that it has selected as a basis for negotiation the firm's proposal for a boiling water nuclear power reactor for the Elk River atomic power station in Minnesota of the Rural Co-operative Power Association.

Leeds and Northrup Company

A completely integrated control system for a nuclear electric power plant was demonstrated by the Leeds and Northrup Company at the exposition. The demonstration comprised an operating schematic model of a boiling-water nuclear power plant, and "package" control system that regulates the entire plant automatically. "Nuclear" activity for the demonstration was supplied electronically by a nuclear reactor simulator. This instrument automatically duplicates the operating conditions of an actual reactor. The model reactor was cut away to show the control rod activity and steam formation within the reactor vessel. The "steam" then passed to a model steam turbine to illustrate the generation of electric power for ultimate distribution to the consumer through transmission lines. The sections of the control system which regulate the electric power generation and transmission are similar to the firm's instrumentation presently in use for this application. However, with a nuclear reactor to produce steam, rather than a conventional coal or oil-fired boiler, the overall control system also includes the reactor control instrumentation. This part of the equipment is similar to the control systems that the company has been supplying for various nuclear reactors in America and abroad. At the exhibition, operators started the demonstration by "lighting off" the model plant, then bringing the reactor up to full power, putting the generator on the line with automatic control, and finally dropping the load to shut down the plant. All instruments received and reacted to the same kind of signals they would encounter in control of an actual nuclear power system, and ran the model plant as an integrated automatic "package." Another interesting development displayed at the firm's booth was the "Module" amplifier unit. It is well known that a reactor requires large numbers of electronic sensing devices which generate signals to inform the operators. These signals represent temperature, nuclear activity and many other conditions, but they are not powerful enough to be fed directly to the instruments; they must first be amplified. The new modular amplifiers may help to keep a reactor running in emergencies, because each module not only does its own job, but serves as a standby unit for another one. Servicing is said to be simplified by this standardisation and also by the plug-in nature of the devices. The modules are less than half the size of previous equivalent amplifiers—they measure 8in by 8in instead of 8¼in by 19in—and several representative units are shown above.



Leeds and Northrup "Module" amplifier units employed in control systems of nuclear reactors

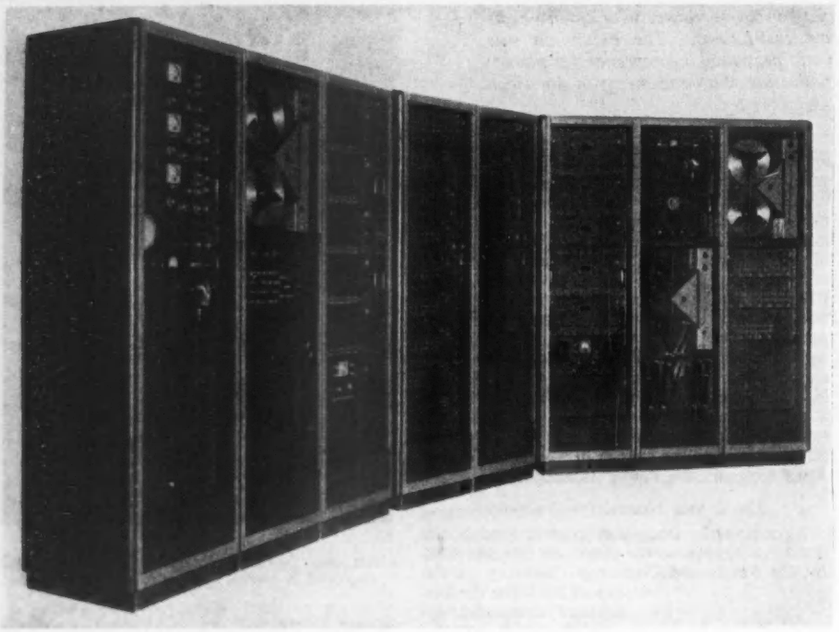
Minneapolis-Honeywell Regulator Company

A major development in reactor instrumentation exhibited by the Minneapolis-Honeywell Regulator Company, of Beltsville, Maryland, was the "Honeywell" scram monitor and transient recorder. As shown on page 752 the system comprises two separate magnetic tape systems used in conjunction with each other to monitor the operation of a reactor. The scram monitor system has both a tape loop recording system and a tape reel recording system. The tape loop recording system has enough tape capacity for recording on a ten-second loop. This time can be increased or decreased depending on the system requirements. As long as the input data signals are not interrupted by a scram signal, the loop is continuously erased and rerecorded on the reel transport to obtain a permanent record. Subsequent input data signals are then recorded on the reel transport from the playback head of the loop transport to form a permanent record. A timer cuts off the reel transport after a fifteen-minute period. This time may be varied as the system requirements dictate. The scram monitor system has no playback facilities.

The transient recorder has facilities for recording twenty-nine data signal inputs on a reel transport for permanent storage. Voice signals and time signals are multiplexed on a single channel. All data recording is accomplished with FM techniques affording a high degree of accuracy; voice and time signals are amplified and recorded with direct recording techniques. The transient recorder, unlike the scram monitor, has playback facilities. These playback facilities can be used to reproduce recordings made on

the transient recorder, or on the reel transport of the scram monitor. Two FM signal discriminators are provided for playing back any two of the data signals simultaneously. A patch panel is used in selecting the data signals applied to the signal discriminators.

A voice playback amplifier mounted in the transient recorder reproduces the recorded voice signals, timing signals, and the output of the rod microphone pre-amplifier. The output of the rod microphone is not only recorded through one FM channel, but is also applied directly to the voice playback amplifier. The scram monitor can be used to record twenty-nine channels of data in conjunction with the transient recorder, thereby making available fifty-eight channels for data recording in special data recording programmes. The reel transport in the transient recorder can be used at any one of four speeds. This choice of speeds is convenient during playback since the data may be played back rapidly for a quick look at the data, or slowly so that it can be fed to associated digitising equipment. When the reel transport is used at slow speed during playback, the demodulated data frequency is low enough so that it can be recorded on direct writing instruments.



Minneapolis-Honeywell scram monitor and transient recorder with two magnetic tape systems

The reference signal recorded on both systems is used during playback for wow and flutter compensation of the signal. The signal is used in conjunction with a compensation discriminator in which the discriminator detects any deviation in the reference frequency caused by a change in tape speed and injects a correction signal into the signal discriminator to overcome this deviation. A calibration control unit is supplied to inject precisely calibrated voltages into the FM recording oscillators to cause a signal that will serve as a calibrated check of the accuracy of the oscillators. These voltages can be inserted either manually or automatically. The scram monitor is mounted in three racks, the transient recorder in three racks, and the data pre-amplifiers and their associated power supplies are mounted in two racks.

Battelle Memorial Institute

In addition to the 1MW swimming pool research reactor, the display of the Battelle Memorial Institute of Columbus, Ohio, emphasised the work in the field of reactor materials technology being conducted at the Institute. Battelle has been active in reactor materials research and development since 1942. This experience of the staff, augmented by a completely modern assembly of the equipment required for research, development and handling of all reactor materials, has made the Institute an important centre for nuclear research. Facilities and equipment which cover the whole field of reactor materials technology have been developed and are available. Typical of the activities in which Battelle has been engaged are the design, fabrication and evaluation of fuel elements and fuel-element components, the preparation and evaluation of structural materials for reactor service, the study of solid moderators and the study of coolants.

Extensive facilities and equipment are required for reactor materials research. This is because few materials can be obtained in the condition required for reactor application, and because often special techniques are necessary in their fabrication. Materials of interest and in the state of purity desired may be prepared by techniques ranging from chemical extraction to the deBoer technique of vapour deposition. Powder metallurgy, in which Battelle has much experience, may be employed to consolidate material. Over fifty arc- and vacuum-induction melting furnaces, ranging in capacity from a few grammes to 200 lb, are available for alloy development. Forming may be accomplished by forge hammers or presses, whose capacities vary up to 700 tons. Rolling and shaping are accomplished in rolling mills that can produce uniform material ranging in thickness from foil-thin sheet to heavy plate 5in thick. This equipment is supplemented by swagers, wire-drawing benches and the complete facilities of a modern machine shop. In addition to these facilities for the processing of normal uranium and other reactor materials, an area designed to cope with the special problems encountered in the processing of uranium-235 specimens is available.

Equipment is also available for the fabrication of ceramic specimens by all of the conventional techniques. Ceramic fuel-element materials in tubular and rod form are made with a special extrusion press that can handle batches of pilot-plant size and still maintain a critical control of pressure and speed of extrusion. The special equipment necessary for hot and hydrostatic pressing is also available. Furnaces with operating ranges to 5000 deg. Fah. and a complete dust-free facility for handling beryllium oxide and other toxic powders are provided.

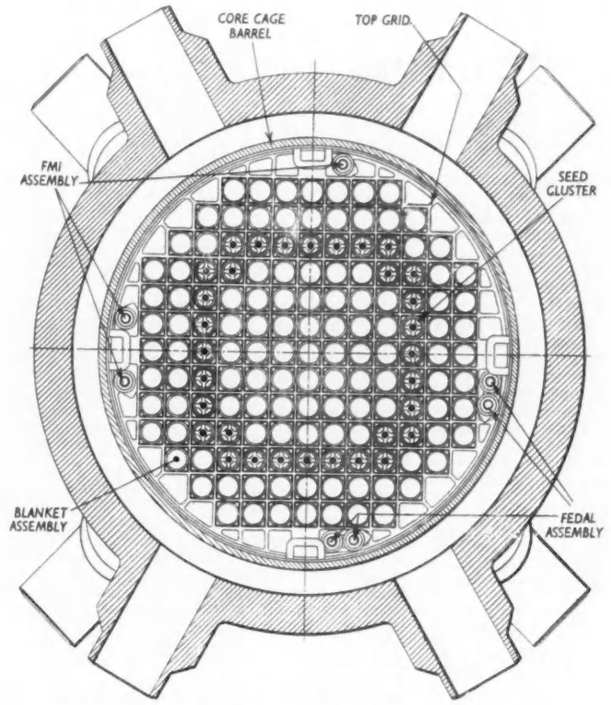
In the study of the reactor materials, critical examination must be made to identify the constituents and the characteristics. Several well-equipped metallographic and petrographic laboratories with all the required equipment for determining constitutional diagrams are at hand. Apparatus for thermal analysis, X-ray and electron-diffraction studies, high-temperature diffraction, electron microscopy, spectroscopy, and wet chemistry analysis is also present. Special equipment has been constructed for heat-transfer measurements of both simple and complex fuel-element and reactor components under simulated reactor conditions. With this equipment, heat-transfer specialists have developed a range of techniques with which even the most involved heat-transfer analysis can be made. Studies of corrosion demand equipment ranging from laboratory beakers for boiling-water tests to a variety of autoclaves for studies at high pressure and high temperature. Thermal-conductivity measurements and specific-heat and thermal-expansion studies up to temperatures near 3000 deg. Fah. are made in special equipment designed and built to accommodate the unusual properties of reactor materials.

Fuel elements often must be clad or coated with a metallic or ceramic material. A variety of techniques and equipment is utilised. Pressure bonding, one method of applying metallic cladding, is done at Battelle on presses with capacities up to 700 tons. Ceramic techniques and equipment that permits the application of coatings to both ceramic and metallic shapes are available. If welding is required, the necessary equipment is available. Battelle electrochemists have learned to make such difficult electro-deposits as aluminium on beryllium, niobium, thorium, uranium and zirconium.

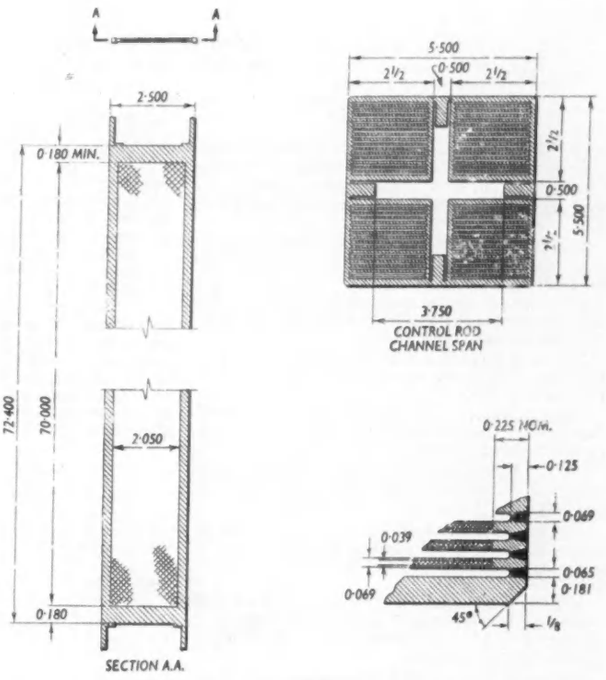
Materials that have performed satisfactorily in fabrication and mechanical testing are irradiated to determine the performance under actual reactor conditions. Such irradiation is carried out in the Battelle Research Reactor or in other reactors. The irradiated specimens are inspected and are evaluated in the hot-cell facility of the Institute, which is equipped to handle them under any desired set of circumstances. Numerous complex reactor heat-transfer problems have been studied, both analytically and with the aid of computing equipment. Where the necessary physical-property data are not available for such calculations, measurements are made. The research team is aided by various theoretical and practical specialists. Mathematicians, utilising analogue and digital computers, are prepared to solve a wide variety of reactor-design and control problems. This combination of skilled personnel, adequate facilities and equipment used by the Institute promotes effective research on any facet of reactor technology from material problems to the study of complete reactor systems.

Westinghouse Electric Corporation

The exhibit of the Westinghouse Electric Corporation stressed the 60MW atomic power station at Shippingport, Pennsylvania, which employs a Pressurised Water Reactor system. The data released at the Atomfair included some particularly interesting details concerning the final fuel arrangement of this reactor. A seed-and-blanket design was chosen for the pressurised water reactor, since it uses a minimum of enriched uranium and makes extensive use of natural uranium. The seed fuel is principally uranium-235 ; the blanket fuel is natural uranium dioxide. Initially, it is uranium-235 that makes it possible to start and maintain a nuclear chain reaction. However, 50 per cent or more of the power is derived by fission in the blanket, perhaps approaching 60 per cent at the end of the seed life. Of the 145 total fuel assemblies, thirty-two are the highly enriched seed assemblies which are arranged in a hollow square with blanket assemblies both inside and outside the seed, as shown opposite. In this arrangement a core is produced which utilises neutrons leaking from the highly enriched seed elements to cause fission in the natural uranium of the blanket assemblies. The seed fuel contains approximately 165 lb of uranium-235. The natural uranium blanket fuel contains 0·7 per cent of uranium-235. The uranium-235 in the blanket material is dispersed throughout the uranium-238 and cannot by itself sustain a chain reaction. Moreover, the hollow square arrangement of seed assemblies, even in the presence of water, cannot sustain a chain reaction without the help of



Arrangement of core of Pressurised Water Reactor at Shippingport



Design details of initial charge of fuel elements in PWR at Shippingport

neutrons reflected from at least a portion of the blanket. The drawing also shows the flow measurement instrumentation (FMI) and failed element detection and location (FEDAL) assemblies.

During operation, some of the neutron output of the fissionable uranium-235 is absorbed in the uranium-238, producing plutonium-239, which is also fissionable by thermal neutrons. Plutonium fission is added to that of uranium-235 as a source of energy. Since the quantity of plutonium builds up during the life of the core, the blanket material will produce an increasing proportion of the overall power by "burning" the plutonium in place. The life of the seed is estimated to be at least 3000 hours at full power. The blanket material should last more than one seed life.

For this first pressurised water reactor core design, the seed-and-blanket arrangement was selected to capitalise on the following advantages:—(1) This type of core reduces the need for enriched uranium and permits an extensive use of natural uranium; (2) the core, by concentrating the enriched uranium in the seed, reduces the area that must be controlled and, hence, requires a minimum of control rods and associated mechanisms; (3) this core has a negative temperature coefficient of relatively large magnitude, ensuring stability and safe operation.

The seed material is contained in assemblies 5½in square in cross section and about 110in long. The active fuel has a nominal length of 70in. The seed fuel is alloyed with zirconium to form the "meat" in a sandwich which is clad on the outside with Zircaloy-2. This is rolled out into thin plates separated from each other by narrow passages allowing the coolant to flow vertically between adjacent plates. Groups of these plates were welded into square sub-assemblies with spacers between them to form a cross-shaped channel for the control rods, as shown above. There are thirty-two seed assemblies, arranged in the form of a hollow square, spaced 6in apart. Control rods are moved into and out of the seed assemblies by drive mechanisms mounted in the closure head of the reactor pressure vessel.

The uranium dioxide blanket fuel material is contained in assemblies having approximately the same overall dimensions as the seed assemblies. There are 113 blanket assemblies—forty-five inside the hollow square formed by the array of seed assemblies, and sixty-eight outside. The uranium dioxide, in cylindrical pellets, is sealed in tubes of Zircaloy-2. The fuel rods so formed are approximately 10in long and $^{13}/_{32}$in in diameter. Each blanket assembly contains seven bundles of 120 rods each, stacked one above the other. Space is provided in the blanket assembly to add an eighth bundle.

The pressurised water reactor design allows fuel to be replaced in two ways. One is to remove and replace the whole core, as shown in Fig. 11, page 484, March 28; this requires taking the closure head off the pressure vessel. The other is to remove and install individual fuel assemblies by working through the fuel ports without removing the closure head. The apparatus for this is described below.

United Shoe Machinery Corporation

The Atomic Power Department of the United Shoe Machinery Corporation, of Beverly, Massachusetts, displayed interesting data relating to the refuelling equipment which the firm recently supplied for the PWR atomic power station at Shippingport. This equipment was designed to remove or replace the 10ft long fuel cells by entering through any of the ten reactor head access ports. At the time of refuelling, the cells themselves will be highly radioactive and will produce heat and radiation even after removal from the vessel, due to the decay of the fission by-products they contain. The necessary shielding and cooling is provided by flooding a concrete canal above the reactor vessel with water to a depth of 20ft. This required that all reactor refuelling operations must be remotely performed by equipment situated in and above the canal. The extraction tool was to reach through the shielding water into the reactor vessel and continue downward through approximately 10ft of hot reactor water to the top of the fuel elements. Any one of the 145 fuel assemblies, each weighing approximately 600 lb, was to be located accurately, unlatched from the grid, and withdrawn. New elements would be replaced in the vacated spot and positively locked into the grid structure. The equipment had to operate without causing damage to the fuel elements, as any rupture of the cladding material would cause a serious contamination problem.

Four major components make up the PWR refuelling system. These are the handling crane, a power-driven tool post and extraction tool, and underwater closed-circuit television camera, and a control console. The crane consists of a bridge and trolley structure straddling the canal and traversing its entire length on rails; it was illustrated in Fig. 12, page 484, March 28 last. A 31ft crane tower is mounted on the trolley and supports the ways for the vertically sliding tool post. The extraction tool, 45ft in length, is made up of a tool post, tool head and extension arm, and associated drive mechanism. The tool head, for latching to the fuel elements, is positioned by means of the extension arm which can offset it from the centre-line of the tool post. At the upper end of the post is the drive mechanism for operating the head through its rotation and extension motions. Although the system is designed to operate "blind," an underwater, closed-circuit television camera, associated positioning mechanism and a monitor are available for remote viewing of the operation. The master control console is situated on the deck of the crane trolley, and comprises the necessary drive controls, synchro position indicators and cathode-ray load and bending indicators. One man can operate the crane, extraction tool, and television camera accurately and reliably from this remote position.

The individual replacement of a fuel element is performed by first opening the appropriate fuel access port of the reactor head. The canal is then flooded. Using the bridge and trolley drives, the crane and extraction tool are positioned on a predetermined set of co-ordinates over this access port. The extraction tool, with its head aligned with the post, is lowered until the head has entered the access port. At this point an electronic centring device indicates the necessary corrections required of the vernier crane drive controls to position the tool head precisely with respect to the grid structure. The tool head is positioned over the desired fuel element by means of the azimuth and extension drives.

Exact and positive latching to the fuel elements is accomplished by lowering the tool post until the tool head has entered the fuel element coupling head, at which time the tool head is rotated and coupled positively to the fuel element. A load sensing device in the tool head transmits further intelligence to the operator for final adjustments to permit the tool head to enter the fuel assembly precisely. In addition, the load sensing device accurately determines the direction and magnitude of the load on the tool head. During the coupling motion the fuel assembly is also unlatched from the grid pocket, and thus is free to be removed. The tool post and fuel element are then raised until the fuel element is clear of the grid structure. The extension arm, tool head and fuel element are then brought back into concentric alignment with the tool post and the access port, and are withdrawn from the reactor. New fuel assemblies to replace the spent fuel elements are then installed by the reverse procedure.

(*To be continued*)

Personal and Business

Appointments

MR. R. F. SIMMONS has been appointed sales manager of Appleton and Howard, Ltd.

MR. STANLEY B. HARTSHORNE, A.M.I.Mech.E., has been appointed chief engineer of Henry Meadows, Ltd.

MR. D. N. STEWART has been elected chairman of the Dry Dock Owners and Repairers Central Council for 1958/9.

MR. J. COLES has been appointed assistant to the sales manager of the handling equipment division of Fred Myers, Ltd.

MR. L. C. BURKE has been appointed a director of Standard Telephones and Cables (South Africa) (Proprietary), Ltd.

VERITY'S, Ltd., has announced that Mr. William Armour has been appointed manager of the newly formed " Alux " division.

MR. SEBASTIAN Z. DE FERRANTI has been appointed managing director of Ferranti, Ltd. Sir Vincent de Ferranti remains chairman of the company.

MR. J. G. SMITH, M.I.C.E., has been appointed a deputy chief engineer (civil engineering) on the highways engineering staff of the Ministry of Transport and Civil Aviation.

THE ELECTRIC VEHICLE ASSOCIATION has announced that Sir Wavell Wakefield has been elected president for the fifth year in succession. Mr. J. H. Cansdale has been elected chairman.

MR. R. M. DOUGLAS has been elected president of the Federation of Civil Engineering Contractors in succession to Mr. A. M. Holbein. Mr. E. C. Beck has been elected chairman in succession to Col. A. C. Newman.

THE BRITISH OIL BURNER MANUFACTURERS' ASSOCIATION states that Mr. W. A. Hubbard has been elected president in succession to Mr. J. R. C. Boyce, the vice-presidents elected being Mr. J. D. Fitzgerald and Mr. W. C. J. Mollinson.

J. STONE AND CO. (HOLDINGS), Ltd., announces that Mr. K. H. Preston, managing director, has resigned and has been appointed executive chairman. Mr. B. W. Preston and Mr. A. J. S. Brown have been appointed joint managing directors.

EDGAR ALLEN AND CO., Ltd., has announced the appointment of Mr. Fred Haigh as personal assistant to Mr. B. B. Green, director and general sales manager. Mr. Irving Somerfield has been appointed home sales manager (steel, engineers' tool, magnet and saw departments). Mr. E. Ashurst has been appointed commercial manager of the foundry division.

HANDLEY PAGE, Ltd., has announced the appointment of Mr. E. W. Pickston as works manager in succession to Mr. H. Smith. Mr. Smith has been appointed consultant. Mr. W. Eames has been appointed assistant works manager, and Mr. W. Corbett has been appointed Radlett aerodrome superintendent in succession to Mr. Eames. Mr. D. C. Robinson has been appointed chief engineer of the commercial division. Mr. E. Manley Walker has been appointed a director, and also manager, of Handley Page (Reading), Ltd. Mr. J. Wilkinson has been appointed works manager of Handley Page (Reading), Ltd.

Business Announcements

JAMES ARCHDALE AND CO., Ltd., has opened a new showroom at its Ledsam Street Works, Birmingham, 16.

THE BRITISH COMPUTER SOCIETY, Ltd., states that it is proposed that a branch of the Society be formed in Leicester.

MR. J. O. DE M. HOPPER, overseas representative of Expandite, Ltd., has left this country to visit distributors in Italy and Yugoslavia.

THE BRITISH ELECTRICAL POWER CONVENTION states that its address is now 26/27, Cockspur Street, London, S.W.1 (telephone, Whitehall 1928).

THE MITCHELL CONSTRUCTION COMPANY has become a limited company within the Mitchell Group of companies. Mr. D. D. Morrell has been appointed managing director.

RANSOME AND MARLES BEARING COMPANY, Ltd., has moved its south-west area office from Bath Parade to new and larger premises at Transom House, Bristol (telephone, Bristol 20437/8).

REMINGTON RAND, Ltd., states that its public relations department has been transferred from Commonwealth House, 1–19, New Oxford Street, London, W.C.1, to Dinneford House, 10–12, Clipstone Street, W.1 (telephone, Langham 8020).

THE INSTITUTION OF HIGHWAY ENGINEERS has announced that a south-eastern branch of the Institution has been inaugurated. Mr. M. C. Leney, A.M.I.C.E., has been elected chairman of the branch and Mr. H. Bowdler, A.M.I.C.E., vice chairman.

MERRYFIELD EQUIPMENT COMPANY, Ltd., announces that Fellows Bros., Ltd., and its associate company, Stringer and Son (Cradley Heath), Ltd., now have a combined London office at Merryfield Equipment Company, Ltd., Spencer House, South Place, Moorgate, E.C.2 (telephone Monarch 5541).

AUTOMATIC TELEPHONE AND ELECTRIC COMPANY, Ltd., THE ENGLISH ELECTRIC COMPANY, Ltd., and ERICSSON TELEPHONES, Ltd., have announced the formation by them of a jointly-owned company for the development and manufacture of transistors and other semi-conductor devices. The company, to be known as Associated Transistors, Ltd., is constructing a factory at Ruislip, Middlesex.

Contracts

METALECTRIC FURNACES, Ltd., Smethwick, has received an order from A/S National Industri, Oslo, for a continuous electric furnace for stress relieving silicon steel transformer laminations. The furnace will have an output of 850 lb per hour and will be rated at 200kW.

HEAD WRIGHTSON AND CO., Ltd., is supplying a single-strand, continuous-sinter plant to the Workington Iron and Steel Company, a branch of the United Steel Companies, Ltd. The plant, which will cost £2,500,000, is designed to produce 12,500 tons of self-fluxing sinter a week. It is expected to be in operation by the end of 1960.

BROOKE MARINE, Ltd., has received an order through the Crown Agents for a twin-screw buoyage and survey ship for the Nigerian Ports Authority. The ship will have a length overall of 206ft 6in by 39ft beam by 18ft 6in deep, and a service speed of 11¼ knots. Propulsion will be by two British Polar M.471 engines, each of 535 b.h.p.

W. H. ALLEN, SONS AND CO., Ltd., Bedford, has been awarded a contract by the Admiralty for the supply of motor-driven main dock and drainage pumping plant for H.M. Dockyard, Rosyth. The plant will comprise two mixed-flow, vertical-spindle pumps, driven by synchronous induction motors through intermediate shafting, together with associated pipework, switchgear and cabling. The main pump, with 52in diameter branches, will be designed to deliver 66,000 gallons per minute of sea-water against a head of 53ft and to operate at heads up to a maximum of 86ft. The drainage pump, with 22in and 20in branches, will deliver 10,900 gallons per minute against a head of 60ft and operate with a maximum head of 96ft. The main dock pump will be driven by a 1425 h.p. duct-ventilated synchronous induction motor, operating on an 11kV, three-phase, 50-cycle supply, and the drainage pump by a 270 h.p. duct-ventilated, synchronous induction motor with an 11kV/415V unit transformer. Both the motors and transformer will be manufactured by Bruce Peebles and Co., Ltd.

Miscellanea

MR. W. MCDONALD.—We record with regret the death, on May 6, of Mr. W. McDonald, managing director of Hackbridge Cable Company, Ltd., and Bryce Electric Construction Company, Ltd. Mr. McDonald had spent fifty years in the cable industry. He began his career with Johnson and Phillips, Ltd., and joined Hackbridge Cable Company, Ltd., in 1915.

ELECTRICAL INSTALLATION CONTRACTING.—The National Inspection Council for Electrical Installation Contracting, 13, Victoria Street, London, S.W.1, has published the second edition of its *Roll of Approved Electrical Installation Contractors*. The contractors listed there have satisfied the Council that they are capable of maintaining a high standard of installation work, based on compliance with the I.E.E. Wiring Regulations.

ALUMINIUM DEVELOPMENT ASSOCIATION.—The report of the Aluminium Development Association for 1957 deals with points of internal and international organisation and reviews the development activities of the various sections. This is followed by research reports of particular sub-committees and of the progress made by individual development groups. The fourth section of the report relates to information services and deals with publications, library services, education and standardisation.

ANODICALLY PROTECTED TITANIUM.—Titanium is already giving excellent service in chemical plant handling a wide range of corrosive industrial liquors, and we are informed that the I.C.I. Metals Division has found that this range can be still further extended by anodic protection of the material. It is stated that anodically protected titanium carrying a small impressed voltage can now be considered for use in some of the most difficult situations with which chemical engineers are faced. This opens the way for the development of titanium equipment in which fully immersed parts can be protected by supplying current from heavy-duty batteries continuously trickle-charged, whereby a protective potential is maintained irrespective of any temporary cessation of mains supply.

WRECK RETURNS.—The returns of ships totally lost or broken up for the quarter ended September 30 have been issued by Lloyd's Register of Shipping. Steamships and motorships owned by Great Britain and Northern Ireland lost consequent upon casualty amounted to two ships of 7869 tons gross out of a world total of twenty-seven ships of 76,604 tons gross. The corresponding totals of ships broken up, &c., were thirty-two ships of 102,927 tons and seventy-one ships of 191,124 tons respectively.

LARGE WATER TURBINE MANUFACTURE.—A new shop for the manufacture of water turbines which has been opened at the Alloa works of the Harland Engineering Company, Ltd., provides facilities for the manufacture of the very large turbines and pumps required for hydro-electric and pumped storage schemes. It is stated that with the equipment and space now available the company can produce turbines with outputs in excess of 200,000 h.p. and over 60ft diameter. The new shop is 432ft long by 63ft wide and its height of 45ft to the crane rails gives ample provision for large erection work. Additional plant installed to serve the new shop includes a heavy bending press for plates up to 2½in thick by 5ft wide, a 24ft boring mill, a 30in centre lathe, and an 8in spindle horizontal boring mill.

" MODEL ENGINEER " DIAMOND JUBILEE.—We have received a copy of the special diamond jubilee issue of the *Model Engineer*, which was published on May 1. In addition to a number of articles tracing the progress of engineering model making and the growth of model engineering clubs, this special issue includes a handsome colour section depicting some of the outstanding models of the past sixty years. On the front cover there is reproduced a picture of the " Rocket " as modelled in silver by the late Dr. J. Bradbury Winter. The issue, of course, honours the memory and work of the late Percival Marshall, who, as a young technical journalist in 1898, founded this weekly magazine which continues to assist and encourage the activities of model makers all over the world. We are happy to add our congratulations to the many accorded to the present editor and publishers.

ANTI-WHITE RUST PROCESS FOR GALVANISED STEEL SHEETS.—It is announced by John Summers and Sons, Ltd., Shotton, Chester, that the firm has developed a process to reduce, if not entirely eliminate, the formation of white rust on galvanised steel sheets. The new process, which is already being included as part of the manufacturing technique " Galvatite," galvanised steel sheet, does not diminish the brilliance of the sheet surface nor reduce the spangle. In the past very substantial financial losses have been suffered due to the formation of white rust, during shipment and storage. This formation of white rust appears on the galvanised sheets when they are subjected to unsuitable conditions, especially when rain and changes in temperature cause moisture on the sheets. The chemicals in the small globules of moisture react, destroying the zinc protective coating on the steel. The new coating process prevents the initial reaction taking place.

CHEMICAL ENGINEERING SYMPOSIUM.—The seventeenth meeting of the European Federation of Chemical Engineering will consist of a joint symposium on " The Organisation of Chemical Engineering Projects," which is to be held at Olympia, London, on the occasion of the Chemical and Petroleum Engineering Exhibition. The meeting will take place on June 24, 25 and 26, when the following papers will be presented :—" The Organisation of Chemical Engineering Construction Projects," by Sir Leonard Owen ; " Design Data and Specifications of Requirements, including Site Selection," by J. P. Asquith and L. S. Davis ; " Systems of Project Organisation," two papers, one by K. M. Curwen, and the other by R. E. Bywater ; " Functions of the Contractor," two papers, one by L. B. Baker, and the other by W. H. A. Webb and H. H. M. Jones ; " Programming and Progressing Systems and Meeting Completion Dates," two papers, one by J. O. Dugdale-Bradley, and the other by W. V. M. Kelly ; " Cost Estimating and Control," by P. Brett ; " Plant Commissioning," two papers, one by D. W. K. Barker, and the other by A. F. Cottrell ; " The Analysis and Future Use of Project Records," two papers, one by S. T. Card, and the other by R. Adams.

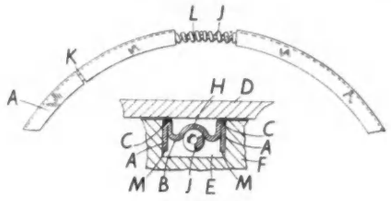
British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.

OIL SCRAPER RINGS

792,922. July 25, 1955.—OIL SCRAPER AND PISTON RINGS, Light Production, Ltd., Liverpool Road, Slough, Buckinghamshire, and Percy White, of the company's address.

According to the invention, a piston ring is characterised in that the two thin split ring portions and the means for spacing them apart are formed integrally from strip hard springy metal which is so fashioned as to provide side flanges and a web portion joined to the outer periphery of each flange and inset from the peripheries. It is found with this arrangement that the ring can be so designed as to fit a piston ring groove of comparatively small radial



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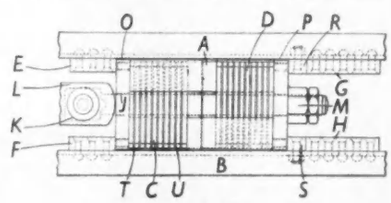
depth—for example, as small as one-twenty-sixth of its external diameter, which is the smallest dimension likely to be required in practice. Referring to the drawing, an oil scraper ring is formed from comparatively thin spring steel about 0·013in in thickness, and is bent into the shape as shown in the lower view. The shape is such as to provide two flange portions *A* joined by a web *B*. As will be seen, the web *B* joins the outer diameter of each flange in a bend *C*, so that the bend faces the cylinder wall *D*, when the ring is in position in a groove *E* in a piston *F*. The rounded bends *C* are preferably provided with a chromium coating. The web *B* is bowed outwardly at *H* to provide a groove on its inner face for accommodating an expander ring *J* formed from comparatively stiff steel wire bent into a helix. The ring is split at *K* in conventional manner. The helix is of such a length that when in position its ends abut one another, and expands the piston ring, thus when the ring is forced into the cylinder the expander is compressed and provides the required degree of radial pressure between the ring and the cylinder wall. The abutting ends of the expander may be held in the required relationship with one another by a pin *L*. The web portion *B* is provided with a number of cross slots which permit the passage of lubricant. When the ring is in a contracted condition within the piston ring groove, the inner edges *M* of the flanges are spaced away from the bottom of the groove, so that in effect the ring is floating.—*April* 9, 1958.

RAILWAY ENGINEERING

792,960. June 5, 1953.—CENTRAL BUFFING AND DRAW GEAR, George Spencer Moulton and Co., Ltd., 13 and 14, Ashley Place, London, S.W.1. (*Inventor: Jack Crosland Spencer.*)

The invention relates to central buffing and draw gear for railway vehicles, more especially for the kind comprising india-rubber springs arranged tandem-wise between the centre sills and double acting so as to cushion both buffing and draft shocks, and to



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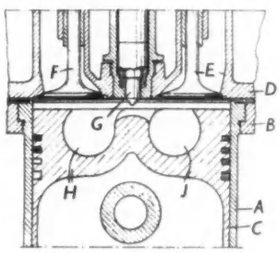
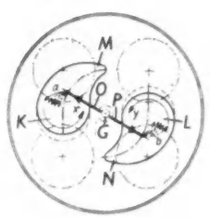
provide an improved gear which is compact in form and in which undue wear of the working parts is avoided. Referring to the drawing the centre sills of the vehicle are represented at *A* and *B*, and arranged tandem-wise between these sills are two columns of rubber springs *C* and *D* operating between front abutments *E* and *F*, and rear abutments *G* and *H* secured to their respective sills. To render the gear double acting so as to cushion both buffing and draft shocks a central draw rod *J* passes through both columns of springs, its front end being connected by a vertical pivot *K* to the rear portion of a coupler shank shown at *L*, and the rear end of the draw rod *J* mounting a nut *M* and lock nut. *O* is the front follower for the front column of springs *C* and co-operates with the abutments *E* and *F*, and *P* is the follower for the rear column of springs *D* and is adapted to co-operate with the fixed abutments *G* and *H* through the medium of detachable blocks *R* and *S*, the longitudinal dimension of which blocks in conjunction with the setting of the nuts on the draw rod *J* determines the initial compression of the aligned columns of springs. Buffing forces are transmitted to the follower *O* by the coupler shank *L*, whilst draft forces are transmitted to the follower *P* by the nut *M*. Each column of springs consists of five foundation plates *T* from each face of which project concentric annuli of rubber, the rings at opposite fcaes of each plate being united by rubber passing through perforations in the plate, and the five units of each column being separated from each other by intermediate plates *U*. With the arrangement illustrated all buffing and draft shocks are cushioned by the tandem springs *C* and *D*, working in parallel—that is to say, each spring undergoes compression commensurate with the linear movement of the coupler shank *L* and the draw rod *J* in relation to the sills of the vehicle in parallel operation.—*April* 9, 1958.

INTERNAL COMBUSTION ENGINES

793,084. April 30, 1956.—FUEL-INJECTION INTERNAL COMBUSTION ENGINES, Daimler-Benz Aktiengesellschaft, Stuttgart-Untertürkheim, Germany.

The invention relates to fuel injection in internal combustion engines in which the fuel is injected into a combustion chamber which is adapted for imparting a rotary movement to the air and fuel-air mixture during a compression stroke. The invention has for its object to effect a particularly thorough division of the fuel in such a manner that a uniform fuel-air mixture is obtained during the injection period over





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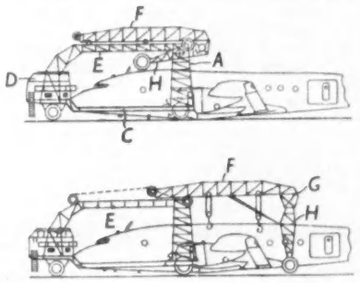
the entire piston area. As shown in the drawing, a cylinder liner *A* is inserted in a cylinder block *B* and a piston *C* is at the top of its stroke. In the cylinder head *D* two intake valves *E* and two exhaust valves *F* are located with an injection nozzle *G* in the axis of the cylinder. In the piston there are formed two trough-like hollows to provide two combustion chambers *H* and *J*, diametrically opposite one another with respect to the injection nozzle. These chambers comprise substantially spherically recessed portions *K* and *L*, and portions *M* and *N*, extending in the circumferential direction and merging into the flat surface of the piston head. As seen in plan, the combustion chambers have a substantially pear-shaped form with the longitudinal axis extending in the circumferential direction. The combustion chambers are disposed uniformly around a circle described from a centre coinciding with the axis of the nozzle. The fuel is injected into the combustion chambers *H* and *J* in two jets *O* and *P*, each approximately at an angle of 45 deg. to the axis of the cylinder, and in such manner that a jet impinges upon a portion of the wall of a respective combustion chamber at a point where the wall portion is inclined. Owing to its impingement on this wall, the fuel is spread substantially in the form of a fan over the wall of the chamber. In the process, it is entrained by the air displaced during the compression stroke into the combustion chambers *H* and *J* respectively, and caused to rotate therein in the direction of the arrows, about axes parallel to the axis of the cylinder, so that a thorough distribution is achieved. Owing to the provision of two combustion chambers, the uniformity of the distribution of the fuel and the gases of combustion over the entire cross section of the cylinder is substantially assisted.—*April* 9, 1958.

CRANES AND LIFTING DEVICES

792,685. November 30, 1955.—TRAVELLING CRANE, Giuseppe Emanuel and Roberto Emanuel, 18, Via Tommaso Grossi, Turin, Italy, trading as Emanuel di Giuseppe e Roberto Emanuel and C. Societa in Accommandita Semplice.

The invention relates to a travelling crane adapted particularly, but not exclusively, for lifting and transporting damaged aircraft. As will be seen from the drawing, the crane comprises a pair of pillars *A* connected at their tops by an arched girder and carried by the rear end of a vehicle having longitudinal frame



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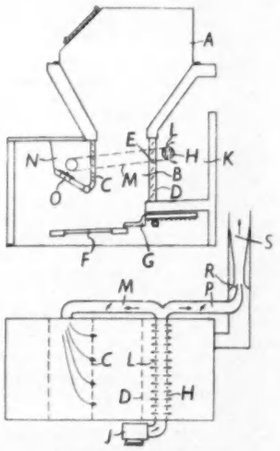
members *C*. The arched girder is connected to the cabin by a girder *E*, the longitudinal members being spaced to permit insertion of the nose of an aircraft. A girder *F* constituting the cross member of the gantry is mounted for longitudinal displacement relatively to the girder *E*, a horizontal girder *G*, approximately normal to the girder *F*, being secured to its end. The girder *G* has hinged to its ends arms *H* carrying at their lower end wheels. The wheels at the lower end of the arms *H* are mounted on carriages which are self-steering with respect to the arms and are fitted with tyres of suitable size.—*April* 2, 1958.

FURNACES

793,023. February 24, 1956.—FURNACE INSTALLATION, Stamicarbon N.V., a Dutch limited liability company, 2, van der Maesenstraat, Heerlen, the Netherlands.

The invention relates to furnace installations for firing solid fuel. The object of the invention is to provide a furnace in which excess secondary air may



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be supplied to the secondary air conduit and in which the excess air will serve not only to reduce the heating of the conduit, but additionally, in the operation of the furnace. The installation illustrated in the drawing comprises a combustion chamber adapted to be charged with fuel from the top and to be horizontally traversed by combustion air passing through its front and rear walls. The fuel, such as coarse coke, is contained in a storage bunker *A* feeding the combustion chamber *B*. The chamber is bounded by two water-cooled side walls, a front wall *C* and a rear wall *D*. Each wall consists of a row of water-cooled pipes, provided with fins *E* to prevent fuel from falling out

between the pipes. The bottom of the combustion chamber is formed by a grate *F*, which is spaced below the front " grate " to enable ash to be removed from the combustion chamber through the gap by a pusher *G*. The air required for combustion is blown into a conduit *H* by a fan *J*. The conduit is located in a secondary combustion chamber *K* behind the rear " grate," and has small apertures *L* through which air flows into the space *K* and effects combustion of the gases therein. The conduit *H* is connected by a conduit *M* to an air box *N* in front of the front " grate " *C*. The greater part of the air from this air box flows between the pipes to the combustion chamber, whereas a smaller portion flows through an opening *O* in the bottom of the air box and into the space under and in front of the bottom grate *F*. The conduit *H* is also connected by a conduit *P* to the nozzle *R* of an injector device provided in the chimney *S* for increasing the draught through the chimney. The amounts of air flowing through the various conduits can be controlled by means of the fan valve and valves in conduits *M* and *P*. The total amount of air needed for operating the furnace flows through the conduit *H* for the secondary air, and this conduit is consequently effectively cooled. Within conduit *H* longitudinal ribs are provided to increase the heat exchange surface. The furnace installation shown in the drawing is constructed as claimed in Specification No. 698,097, and embodies features as claimed in Specifications No. 698,098 and Nos. 698,099 and 698,100.—*April* 9, 1958.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 2, Park Street, London, W.1.

THE STRUCTURAL USE OF REINFORCED CONCRETE IN BUILDINGS

No. CP-114 : 1957. Price 10s. This revised edition of the code issued in 1948 deals with reinforced concrete design and construction as applied to beams, slabs, columns, flat slab construction and walls and bases in buildings. It also deals with floors, roofs and stairs, which were previously the subject of separate sub-codes. It incorporates some important changes and developments, which the Institution considers should lead to increased economy and freedom in design. The recommendations concern materials and strength requirements, also permissible stresses in steel and concrete, which have been increased wherever this could be done with safety.

The design of mixes to a specified strength is now provided for, and for nominal mixes somewhat higher permissible stresses are allowed where the cube strength requirements for the particular mix are consistently exceeded.

Methods for assessing the bending moments and other stresses in the various members, and the permissible loads on columns, are included, and there are general formulæ applicable to any type of steel.

Calculations for beams, slabs and eccentrically loaded columns on a load factor basis are now permitted. Recommendations are made on the practical aspects of concreting, formwork and the bending and placing of reinforcement.

Some guidance on the fire resistance of certain reinforced concrete constructions, based on the recommendations of the Joint Fire Research Organization, is given in an appendix.

COPPER TUBES TO BE BURIED UNDERGROUND

No. 1386: 1957. Price 3s. The tubes covered in this revised standard are suitable for connection by means of compression fittings, or capillary fittings or by bronze or autogenous welding, and are of the type to be buried underground for the conveyance of water, town gas, &c. In the new specification the value of the maximum tensile strength for annealed tubes and the minimum tensile strength for as-drawn tubes has been reduced from 17 tons per square inch to 16·5 tons per square inch ; and the angle of drift has been amended to 45 deg. (the angle now being adopted in all British standards for copper and copper alloy tubes).

Other amendments are a modification of the " freedom from defects " clause to ensure that deleterious films are not present in the bore of the tube ; and a clause which specifies marking with bands of adhesive tape indicating the number of the standard and temper of the tubes supplied, as well as permanent marking of the tubes with the supplier's identification mark. Tubes are standardised on the basis of outside diameter ; this means that the outside diameter selected for each size is that laid down in B.S. 659: 1955, one wall thickness being recognised as standard for each nominal size. Two grades of copper are specified complying with B.S. 1172 and B.S. 1174 ; but by using the designations C106 and C107 they have been further identified with the corresponding alloys in the schedule of copper and copper alloy tubes (B.S. 2871).

Launches and Trial Trips

SUGAR TRANSPORTER, bulk sugar carrier ; built by Hall Russell and Co., Ltd., for Silvertown Services Shipping, Ltd.; length between perpendiculars 370ft, breadth moulded 53ft, depth moulded 28ft, deadweight 6550 tons on 22ft 3in draught ; four holds ; three 125kW diesel-driven generators ; single-acting, two-stroke diesel engines of 3000 b.h.p. at 150 r.p.m. Trial March, 6.

HALIA, oil tanker ; built by Hawthorn Leslie (Shipbuilders), Ltd., for Shell Tankers, Ltd.; length overall 557ft, breadth moulded 69ft 3in, depth moulded 39ft, deadweight 18,000 tons ; thirty-three cargo oil tanks, one main cargo pump room, four vertical centrifugal pumps ; two 550kW, 450V, 60 c/s geared turbo-alternators, one 200kW diesel-driven alternator ; one set of geared turbines, 8250 maximum s.h.p., steam supplied by two water-tube boilers at 500 lb per square inch and 800 deg. Fah. Trial, March 6 and 7.

ARNET ROBINSON, pilot tender : built by Philip and Son, Ltd., for the Mersey Docks and Harbour Board ; length between perpendiculars 165ft, breadth moulded 31ft 6in, depth moulded 14ft 9in, mean draught 10ft 4in, speed 13¼ knots ; 28 pilots ; two six-cylinder National diesel engines, each driving a 375kW main generator and an auxiliary 80kW generator ; single-armature main motor of 920 b.h.p. at 300 r.p.m. Trial, March 13.

PORT INVERCARGILL, cargo liner ; built at Belfast by Harland and Wolff, Ltd., for the Port Line, Ltd.; length between perpendiculars 460ft, breadth moulded 65ft 6in, depth moulded to upper deck 41ft 6in, gross tonnage 8850 tons ; ten passengers ; three complete steel decks, eight watertight compartments, including five holds, one 70-ton, four 15-ton, four 10-ton, six 5-ton derricks, electric winches ; three 360kW diesel-driven generators, one 200kW free-piston engine-driven generator ; Harland and Wolff single-acting, two-stroke, opposed-piston oil engine, seven cylinders, 750mm diameter by 2000mm combined stroke, 112 r.p.m. Trial, March 27.

KANO PALM, cargo liner ; built at the Neptune Works of Swan, Hunter and Wigham Richardson, Ltd., for the Palm Line, Ltd.; length between perpendiculars 469ft, breadth moulded 62ft 6in, depth moulded to shelter deck 35ft 9in, deadweight 11,350 tons on 26ft 6in mean draught ; five cargo holds, MacGregor steel hatch covers, one 50-ton, four 15-ton, two 10-ton, ten 5-ton and two 3-ton derricks, electric winches ; three 250kW diesel-driven generators ; Swan, Hunter-Doxford oil engine, five cylinders, 670mm diameter by 2320mm combined stroke, 5600 b.h.p. at 117 r.p.m. Trial, March 28.

CHICANOA, refrigerated banana carrier ; built by Alexander Stephen and Sons, Ltd., for Elders and Fyffes, Ltd.; length between perpendiculars 390ft, breadth moulded 56ft 6in, depth to upper deck 35ft, twelve passengers ; four holds, fourteen insulated cargo spaces, two eight-cylinder Arcton 6 compressors ; eight 5-ton derricks, electric winches ; two 450kW geared turbo-generators, one 400kW diesel-driven generator ; one set of two-cylinder, double-reduction geared turbines taking steam at 500 lb per square inch and 790 deg. Fah. from two Babcock and Wilcox boilers. Trial, March.

Catalogues and Brochures

LORANT ENGINEERS (LONDON), Ltd., 65, High Street, South Norwood, London, S.E.25.—List No. 584/6 giving details of " Kipp " spanners.

A. A. JONES AND SHIPMAN, Ltd., Narborough Road South, Leicester.—Folder describing precision dividing tables for vertical and horizontal mounting.

BRITISH INSULATED CALLENDER'S CABLES, Ltd., 21, Bloomsbury Street, London, W.C.1.—Publication No. 401 illustrating and describing " MW " power capacitors for 200–600V operation.

GOODENOUGH PUMPS, Ltd., 112, Jermyn Street, London, S.W.1.—Illustrated publication describing automatic self-priming centrifugal pumps. The brochure has been printed in English and French.

JONES AND ATTWOOD, Ltd., Stourbridge, Worcestershire.—Catalogue No. 230 describing " Comminutors," equipment designed to cut up solids into small particles, without having to remove the solids from a flow of liquid.

AYLING NUCLEAR EQUIPMENT COMPANY, Horsham, Sussex.—Illustrated brochure describing remote handling equipment for atomic research work, electronic control gear, testing apparatus and special purpose machinery. The text is written in English, French, German and Spanish, as also are the captions to all illustrations.

STANDARD TELEPHONES AND CABLES, Ltd., Power Line Division, North Woolwich, London, E.16.—Booklet giving technical details of " Ovoil " 33kV three-core oil-filled cables. These cables have oval conductors and are constructed without the use of fillers or steel spiral oil ducts, the interstices being utilised for oil flow purposes.

THE TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, Ltd., Mercury House, Theobald's Road, London, W.C.1.—Illustrated brochure giving details of the products of the company which can otherwise only be obtained from the more detailed publications issued. The company offers more comprehensive literature on any particular product.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., Rugby.—Publication No. G.13026 entitled " Electronics in Industry," presenting a general impression of the electronic control equipment made by the company. Industrial electronic control is illustrated mainly by installation photographs. It is pointed out that the book does not cover all the types of electronic devices and systems manufactured by the company.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

To-day, May 16.—STOKE AND CREWE BRANCH : Royal Hotel, Crewe, " R.F. Induction Heating," J. G. Williams, 7.30 p.m.
Sat., May 17.—OXFORD, READING AND DISTRICTS BRANCH : Collier Lecture Room, Regent's Park College, Pusey Street, Oxford, Annual General Meeting, 7 p.m.

BRITISH COMPUTER SOCIETY

Mon., May 19.—York Hall, Caxton Hall, Westminster, S.W.1, " Four Years of Automatic Office Work," T. R. Thompson, 6.15 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS

Wed., May 21.—LONDON BRANCH : London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, " Cold Cathode Voltage Transfer Circuits," J. H. Beesley, 6.30 p.m.

COMBUSTION ENGINEERING ASSOCIATION

Wed., May 21.—NORTH WESTERN REGION : The Engineers' Club, Manchester, " Grit and Dust Collecting Equipment for the Smaller Plant," C. J. Stairmand, 2.30 p.m.

INCORPORATED PLANT ENGINEERS

To-day, May 16.—Grand Hotel, Brighton, Eleventh Annual Conference, " The Exploitation of Change."
Wed., May 21.—KENT BRANCH : Kings Head Hotel, High Street, Rochester, " Maintenance of Shell Boilers," J. N. Williams, 7 p.m.
Fri., May 23.—BIRMINGHAM MOBILE PLANT DISCUSSION GROUP : Imperial Hotel, Temple Street, Birmingham, " Tower Cranes," Mr. Sutcliffe, 7.30 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN

To-day, May 16.—Annual Conference at Buxton.

INSTITUTE OF NAVIGATION

To-day, May 16.—Royal Geographical Society, 1, Kensington Gore, London, S.W.7, " The Principles of Inertia Navigation Systems," E. W. Anderson, 5.15 p.m.

INSTITUTE OF PHYSICS

To-day, May 16.—NON-DESTRUCTIVE TESTING GROUP : Lecture Room, 47, Belgrave Square, London, S.W.1, " The Characteristics and Design of Ultrasonic Flaw Detector Transducers," D. G. Christie, 6 p.m.

INSTITUTION OF CIVIL ENGINEERS

Tues., May 20.—Great George Street, Westminster, London, S.W.1, " Multi-Storey Construction in Concrete," J. A. Derrington, 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

Sat., May 17.—SOUTH MIDLAND EDUCATION DISCUSSION CIRCLE : Visit to the General Electric Company, Ltd., Witton, Birmingham, 10.30 a.m. ★ SOUTH MIDLAND CENTRE : Visit to B.B.C. Television Transmitting Station, Sutton Coldfield, and Television Studios, Gosta Green, Birmingham, 2.30 p.m.
Mon. to Fri., May 19–23.—RADIO AND TELECOMMUNICATION SECTION : Savoy Place, London, W.C.2, International Convention on Microwave Valves, Monday, 11 a.m. ; Tuesday to Friday, 9.30 a.m.

INSTITUTION OF MECHANICAL ENGINEERS

Mon., May 19.—MIDLAND GRADUATES' SECTION : James Watt Memorial Institute, Birmingham, Annual General Meeting, Film, " Engineering at Calder Hall," 6.45 p.m.
Wed., May 21.—LONDON GRADUATES' SECTION : 1, Birdcage Walk, Westminster, London, S.W.1, Annual General Meeting ; " Napier ' Deltic ' Engine," D. W. Hobbs, 6.30 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

Thurs., May 22.—LONDON BRANCH : 11, Upper Belgrave Street, London, S.W.1, Annual General Meeting, 5.55 p.m.

JUNIOR INSTITUTION OF ENGINEERS

To-day, May 16.—SHEFFIELD AND DISTRICT SECTION : Royal Victoria Hotel, Sheffield, Repeat of the Presidential Address, " The Origin and Function of R.E.M.E.," W. A. Lord, 7.30 p.m.

ROYAL METEOROLOGICAL SOCIETY

Wed., May 21.—49, Cromwell Road, London, S.W.7, Discussion on " The Dynamical State of the Upper Atmosphere," 3.30 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE

To-day, May 16.—39, Elmbank Crescent, Glasgow, All-day Conference on " Metallurgical and Engineering Aspects of Weight-Saving in Steel Structures," 10 a.m.

WOMEN'S ENGINEERING SOCIETY

Tues., May 20.—LONDON BRANCH : Central Electricity Authority Headquarters, Winsley Street, London, W.1, " Rubber as Applied to General Engineering," S. W. Marsh, 6.45 p.m.

Advanced Engineering Courses

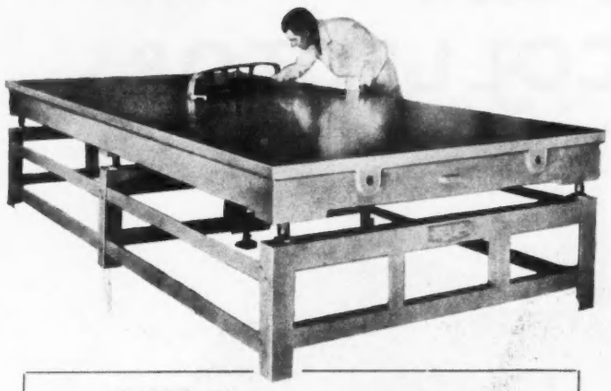
Production Planning and Control. UNIVERSITY OF BIRMINGHAM, INSTITUTE FOR ENGINEERING PRODUCTION, " Southfield," 16, Norfolk Road, Edgbaston, Birmingham, 15. Residential executive course, 9.30 a.m. Monday, May 12, to 4 p.m. ; Friday, May 23. Fee fifty guineas.

Standard Reactor School Course. HARWELL REACTOR SCHOOL, ATOMIC ENERGY RESEARCH ESTABLISHMENT, Harwell, Berkshire. The first six weeks of the course, commencing September 1, will be held jointly at Birmingham, Bradford and Salford Colleges of Advanced Technology, the remaining part of the course, commencing October 15, will be at Harwell Reactor School. The course finishes on December 23. Fee £250.

Statistical Quality Control and Acceptance Sampling. COLLEGE OF TECHNOLOGY, Gosta Green, Birmingham, 4. Three-week course, commencing Monday, September 8. The first two weeks will be devoted to the general principles and procedures involved, and the final week will be devoted to lectures by specialists from industry and to visiting the works of firms employing quality control.

CROWN

SURFACE TABLES



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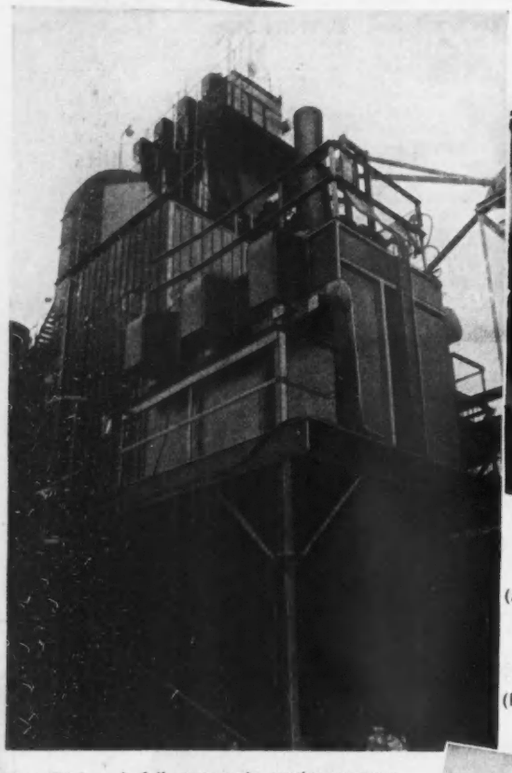
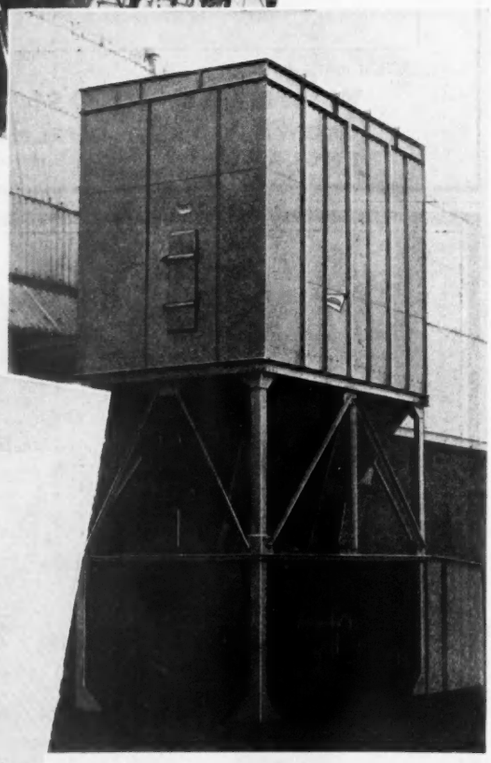


Two Tilghman's fully automatic continuous operating Dust Collectors in service at a carbon black producing plant. The lower one is designed to operate at temperatures from 350°F to 500°F and the one at the top at temperatures up to 270°F.

(Above) Two large collectors designed for handling carbon black, during erection at Messrs. Philblack Ltd., Avonmouth. Photograph by courtesy of Messrs. Philblack Ltd., and Messrs. E. B. Badger & Sons Ltd.

(Below) Special closed circuit, continuously operating chalk dusting plant. Photograph by courtesy of Messrs. Rubber Regenerating Co. Ltd., Manchester.



Model 360 KD.126/1 Dust Collector installed at Messrs. Newton Chambers Ltd., Sheffield. Material handled—foundry dust from a large shot blast room.

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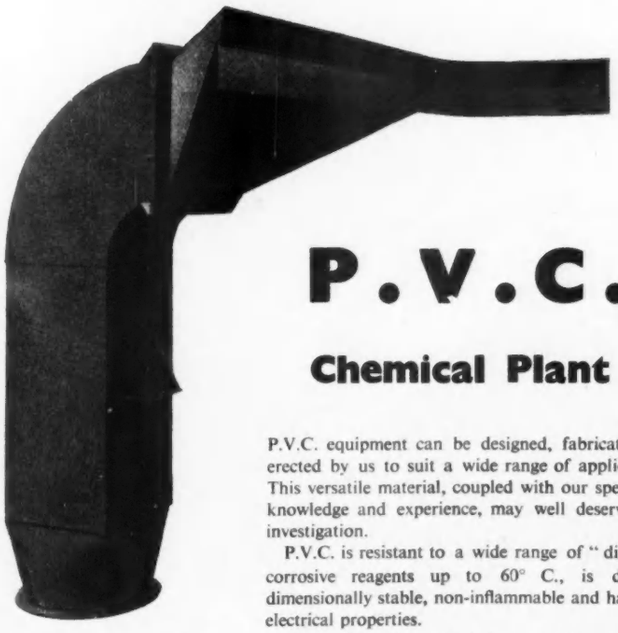

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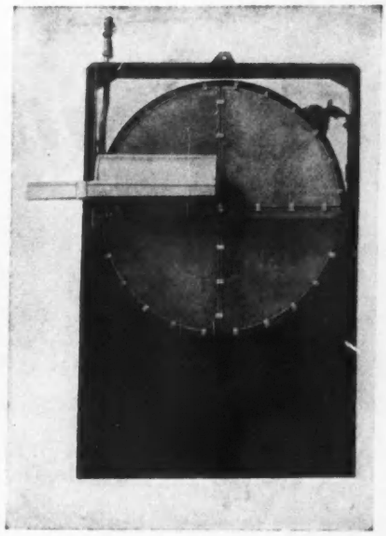

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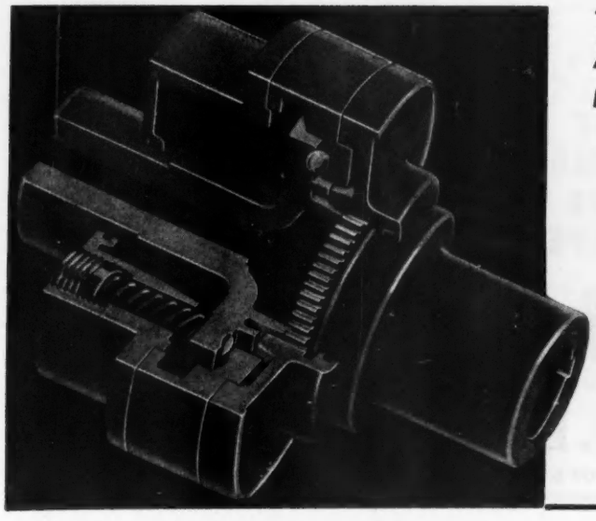

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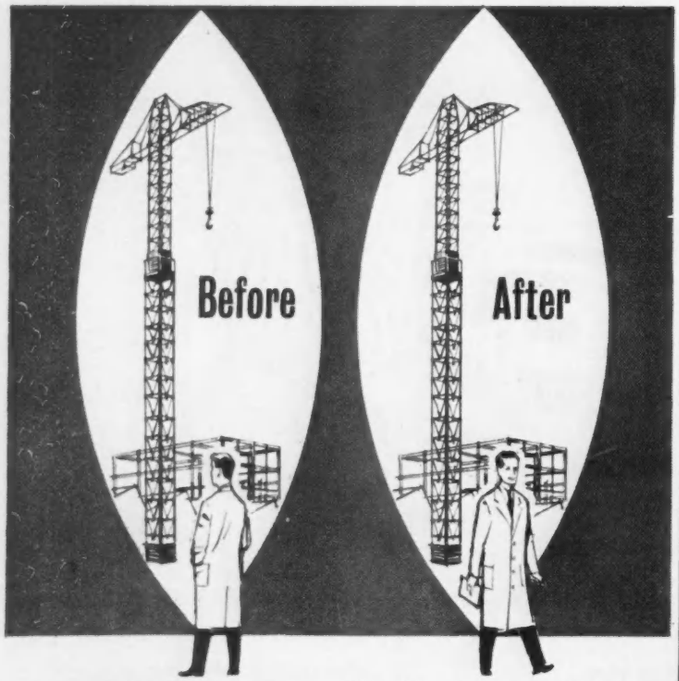

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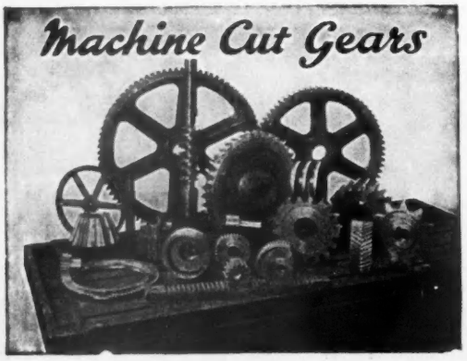

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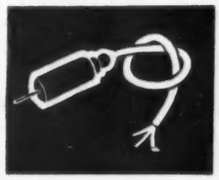

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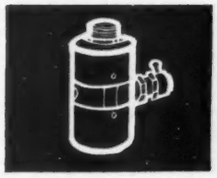

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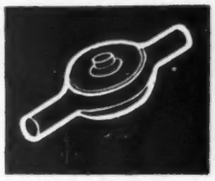

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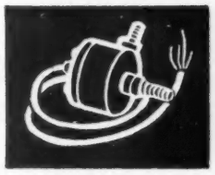

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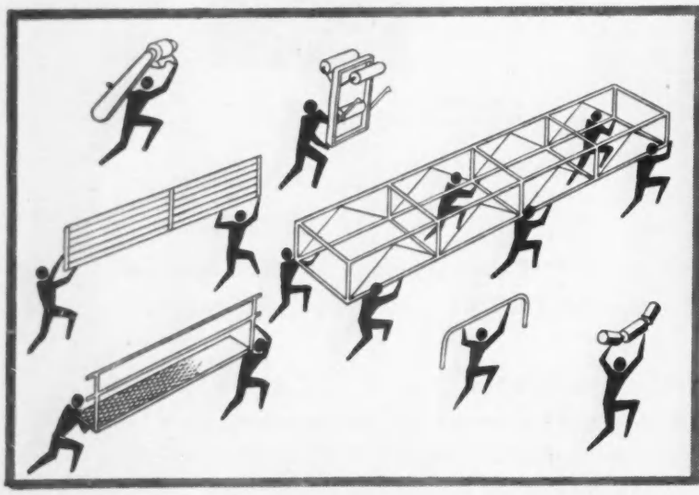

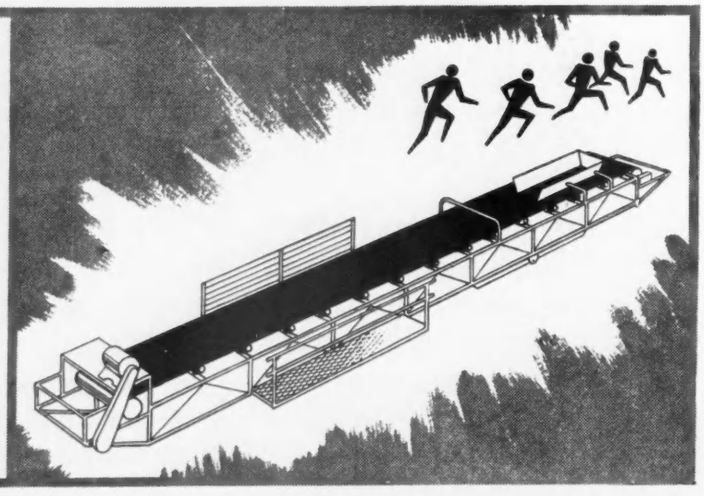

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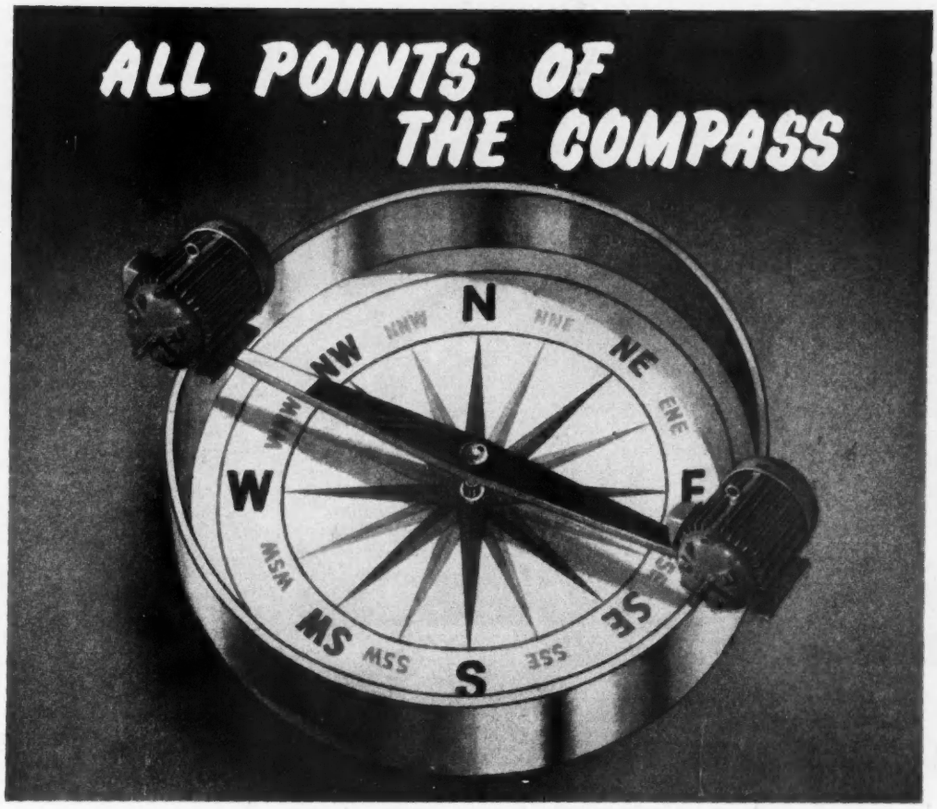

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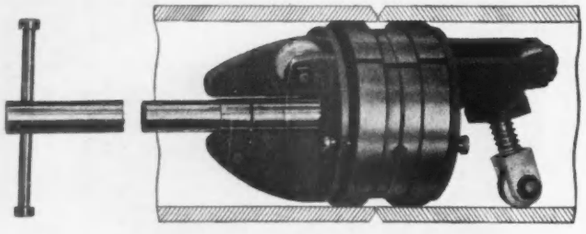

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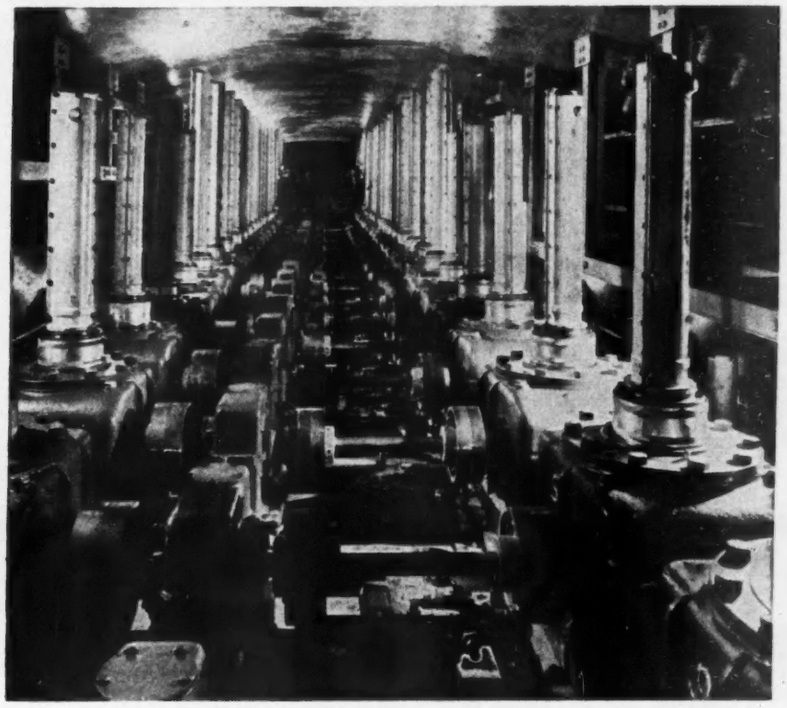

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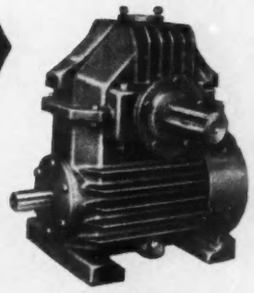

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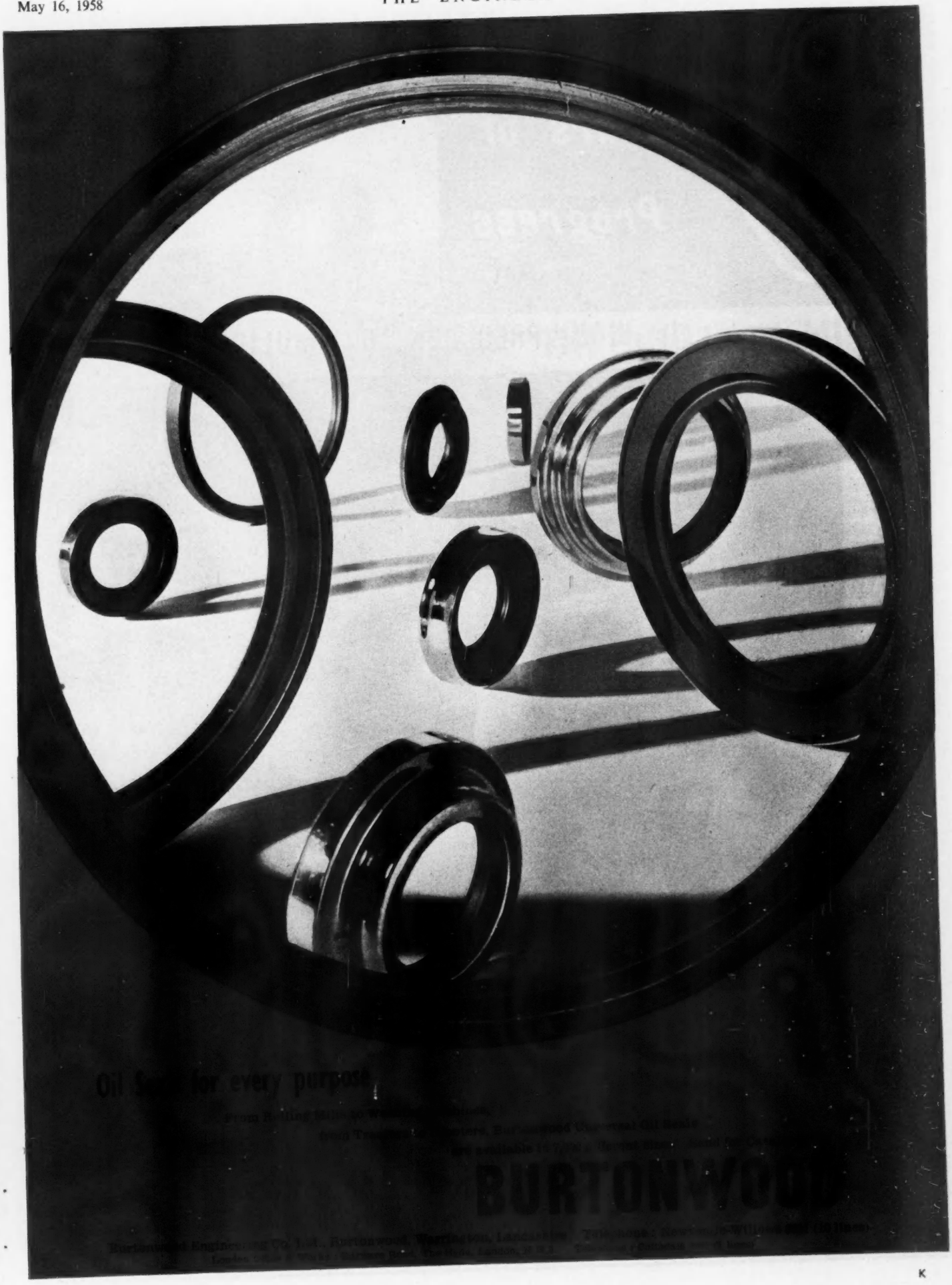
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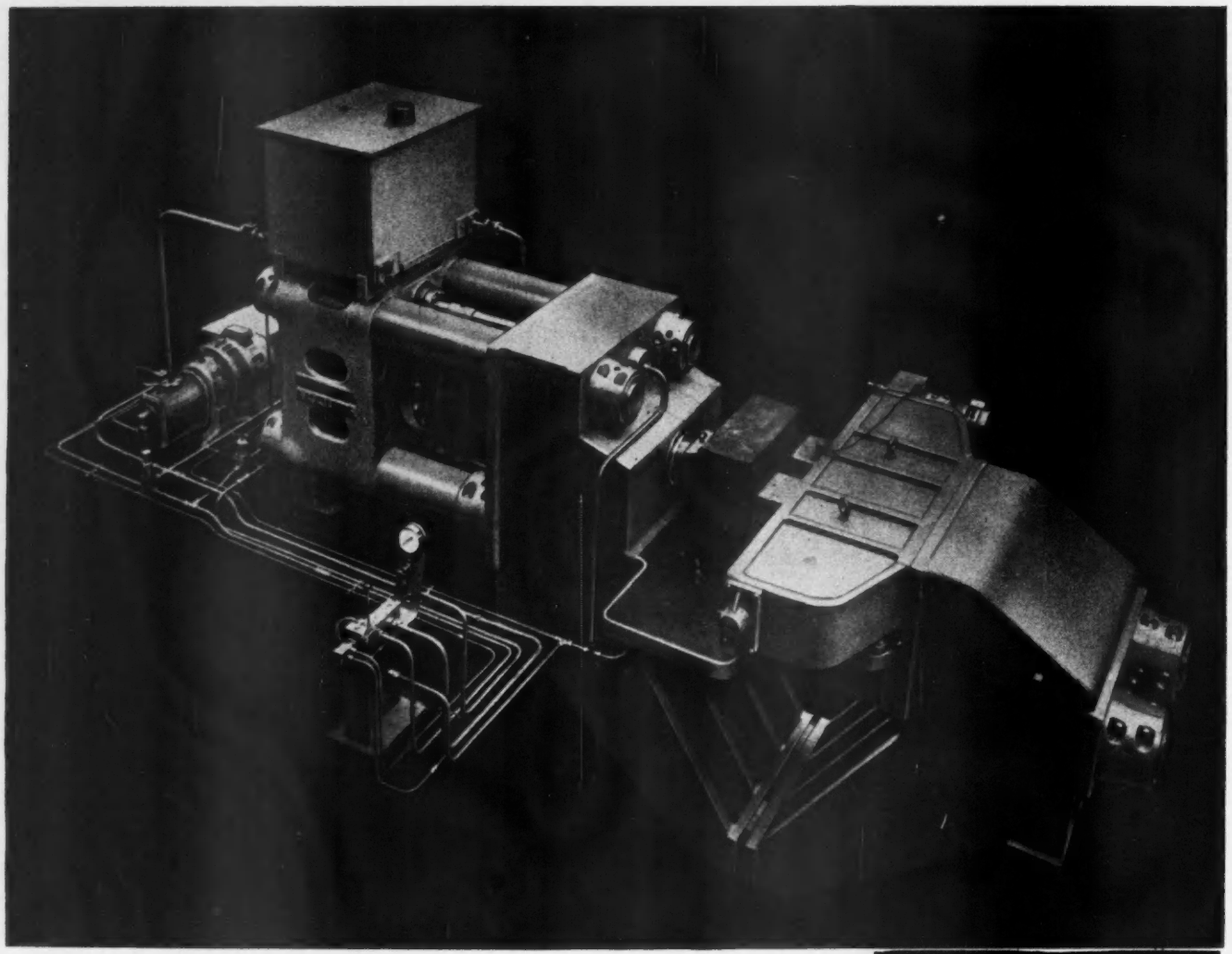

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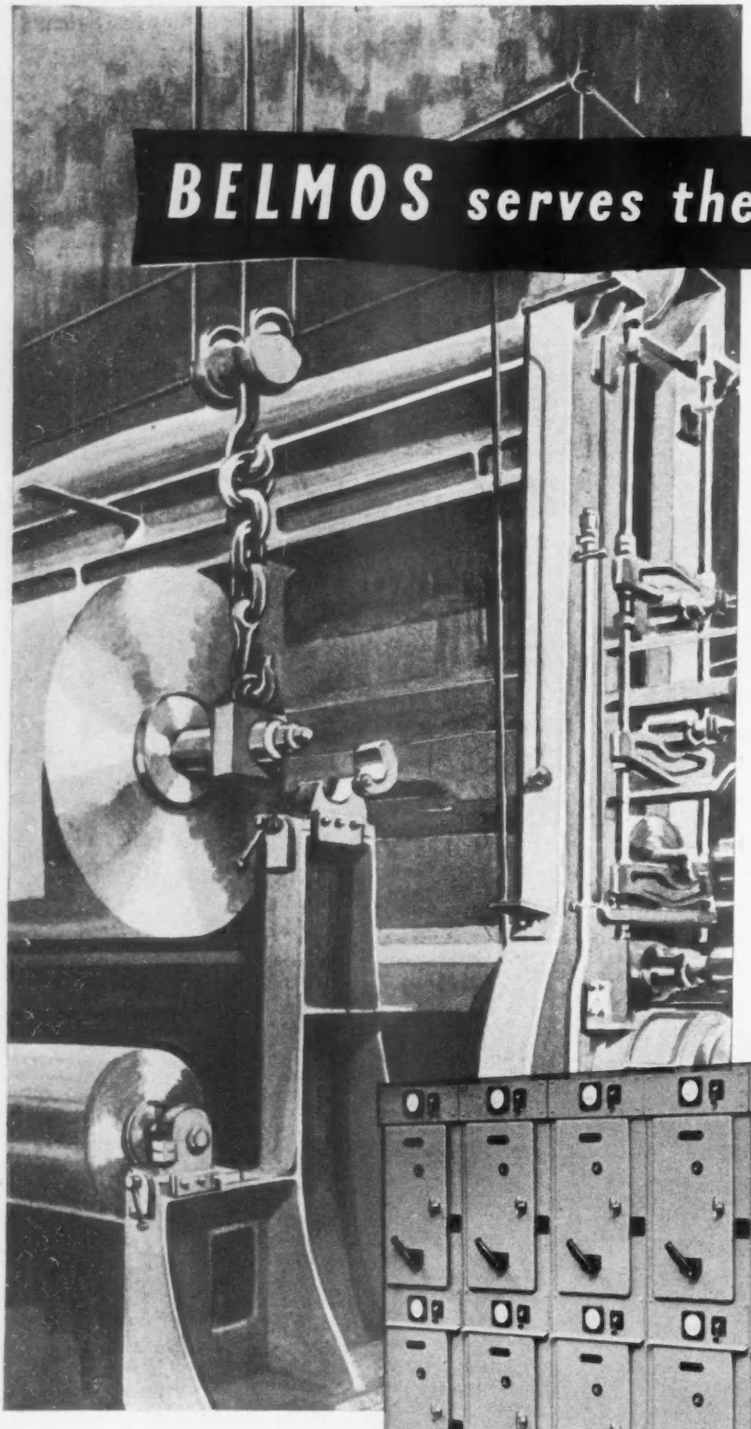
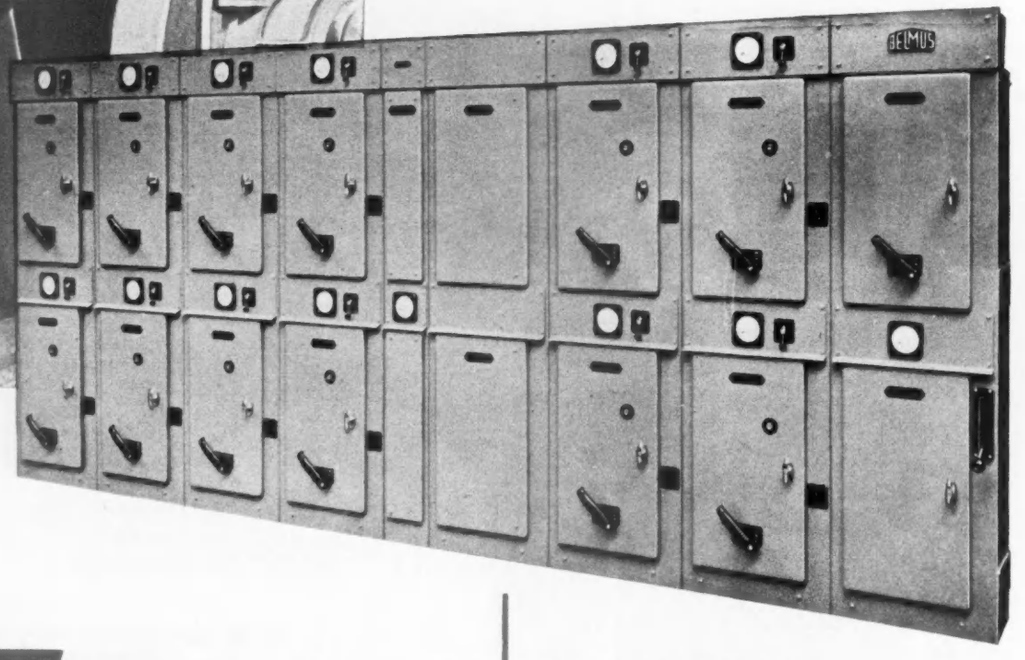


BELMOS serves the Paper Industry

There is little need to emphasise the part played by motor control gear in the making of paper. Belmos control gear has earned the complete confidence of plant engineer and management alike in the paper making industry throughout the world.

With over thirty years' specialist experience in the manufacture of switchgear and motor control gear the company is justifiably proud of the part it is playing in the production of fine papers and boards.

An experienced engineering staff is available at the works and throughout the country, able to advise on the problems associated with the utilisation and application of switchgear and motor control gear.



Double tier Belmos switchboard for controlling motors up to 80–90 h.p., with terminal cubicles in centre of board for the termination of multi-core cables from remote control desk, as supplied to a large paper mill.

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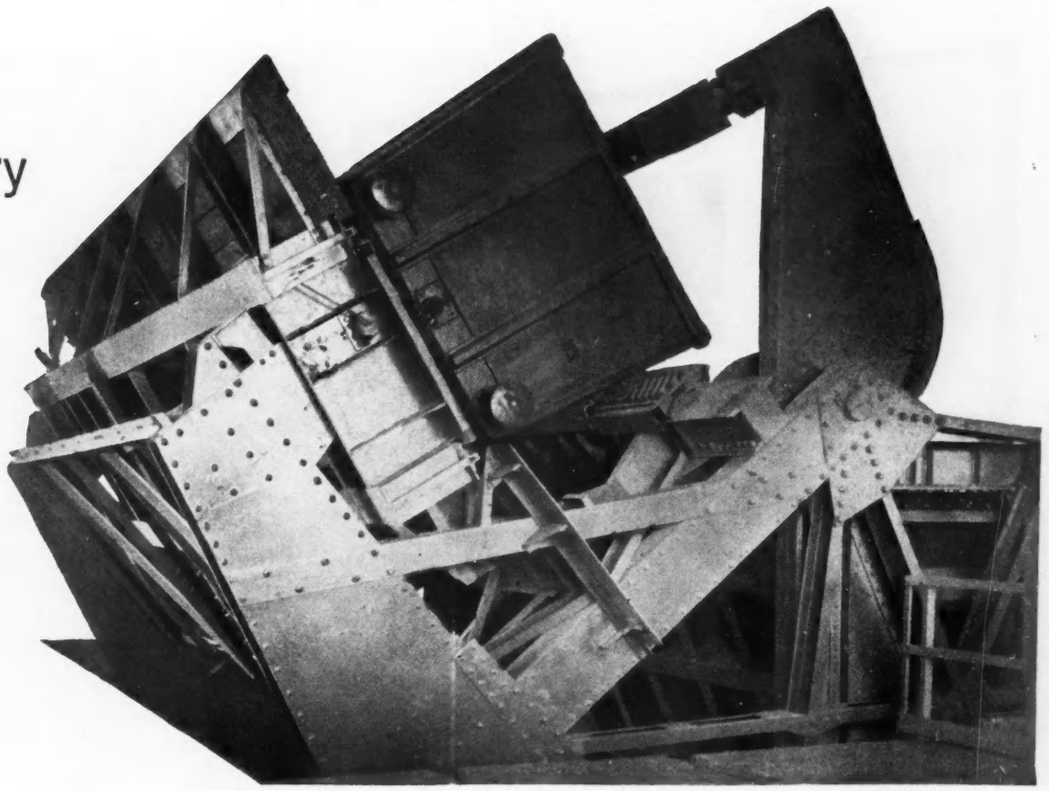

7¼ miles of conveyor belting
at the Seraphim plant of
the Appleby-Frodingham
Steel
Company

Branch of the United Steel Companies Limited.

This complete ore-handling plant was commissioned by Fraser & Chalmers in 1954. It is typical of the many materials handling systems which have been installed by Fraser & Chalmers the world over

FRASER & CHALMERS **MATERIALS HANDLING**

THE GENERAL ELECTRIC COMPANY LIMITED OF ENGLAND · ERITH · KENT

MH236

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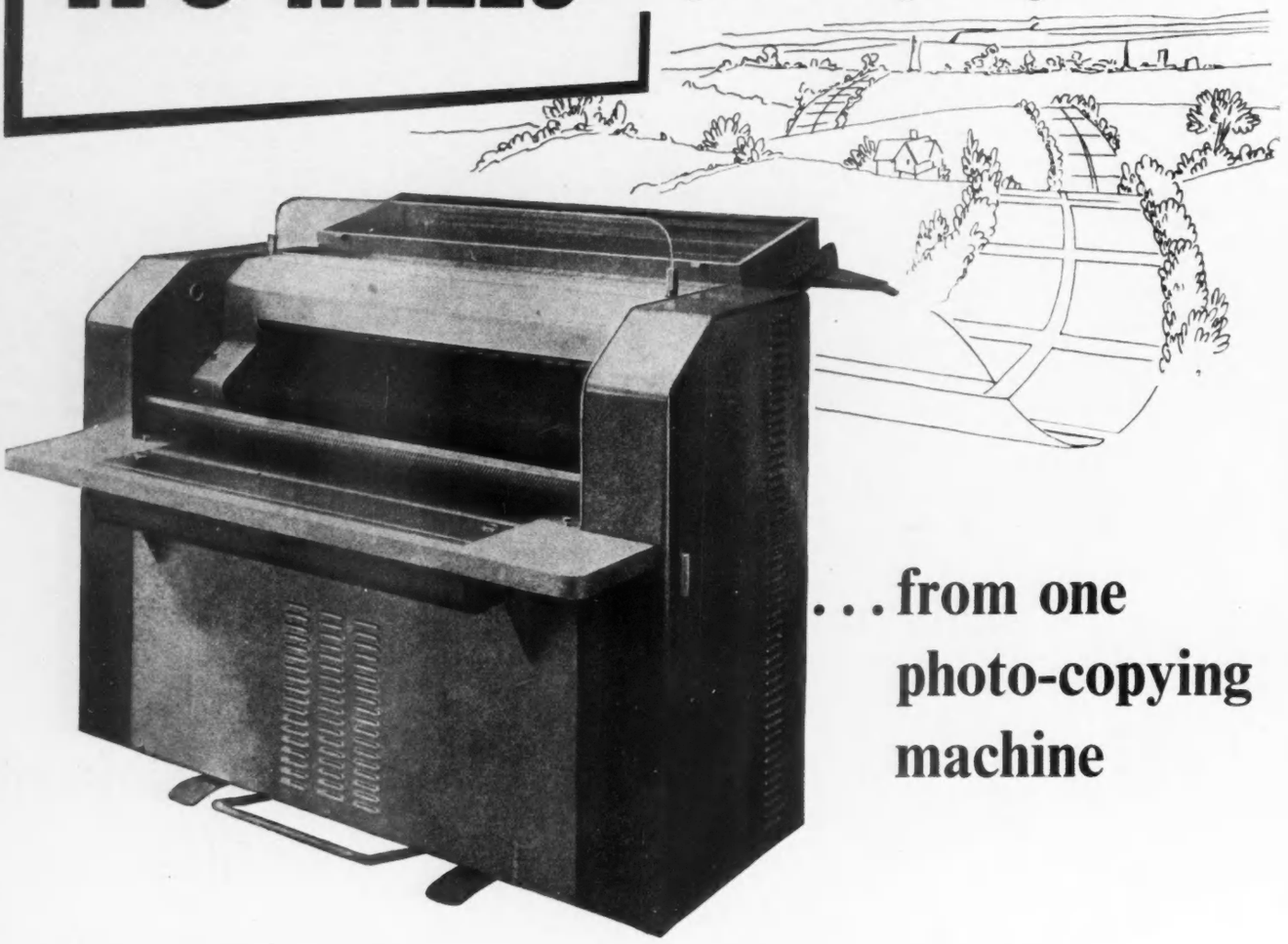
175 MILES *of prints per year...*



...from one photo-copying machine

175 miles of prints a year is the output reported by one regular user of an Azoflex Model 46/35—and that's the sort of output that any busy drawing office can expect. The AZOFLEX photo-printing process combines several unique features. It's the *only* daylight reflex copying process. It's the *only* process to apply a measured quantity of developer irrespective of running speed, thus ensuring optimum quality. It avoids the use of dangerous chemicals and there are no unpleasant fumes. Operation is quiet and free from vibration. Exposing, developing and print delivery are all synchronised to ensure an even flow of finished work at all speeds.

AZOFLEX MODEL 46/35 combined synchronised printer and developer. Capacity: cut sheets and rolls up to 42 in. wide. Printing speed: up to 30 ft. per minute. Dimensions: Height 58 in. Depth 60 in. Width 72 in. Weight 1,100 lb. Price £1,555 (including delivery and installation in the U.K.).

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Enquiries to: Ilford Limited, Industrial Sales Dept. AZ11H, Ilford, Essex. Telephone: ILFORD 3000

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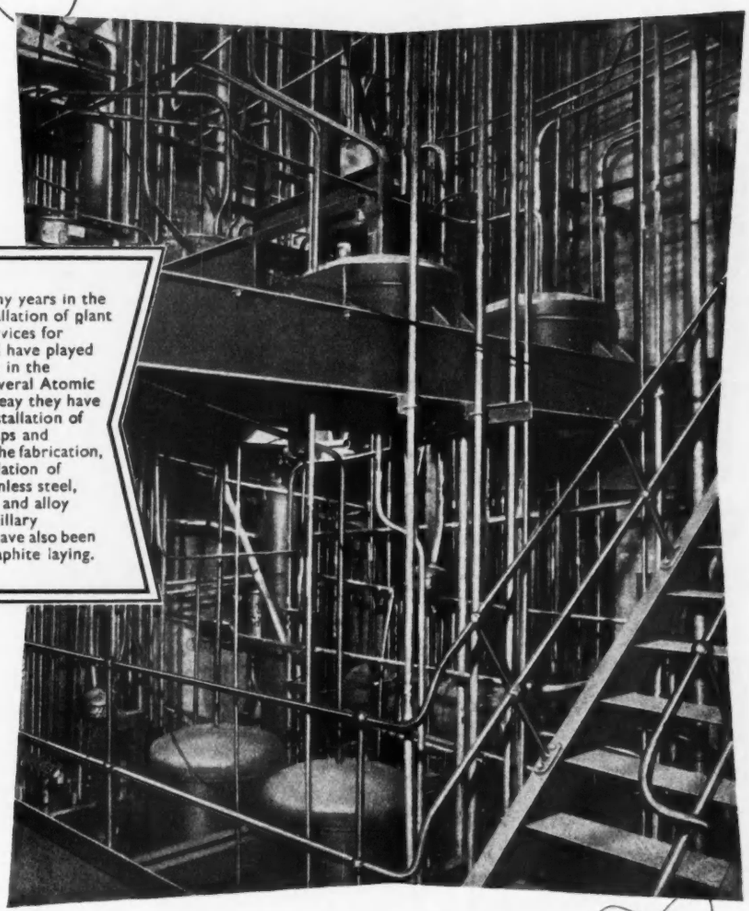
WARDS at DOUNREAY



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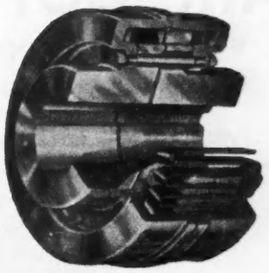

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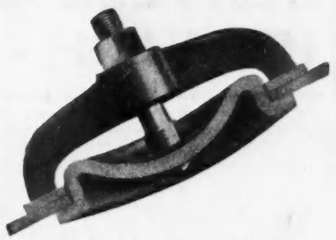

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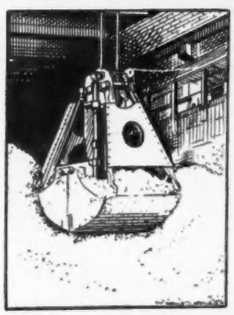

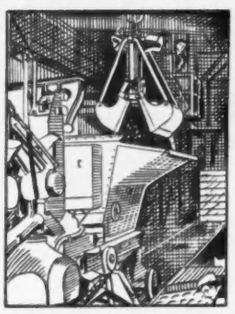

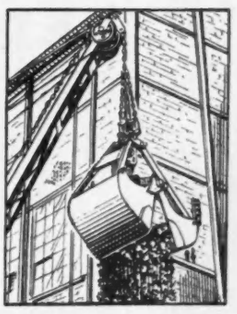

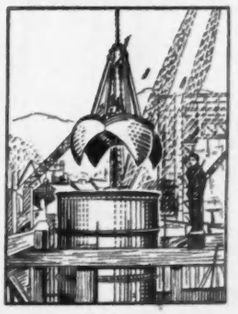

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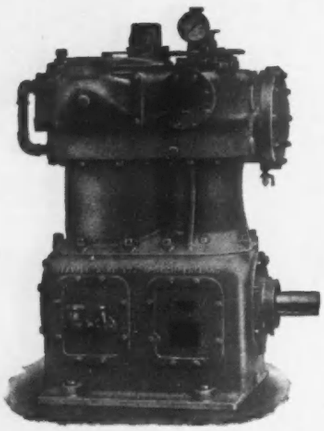

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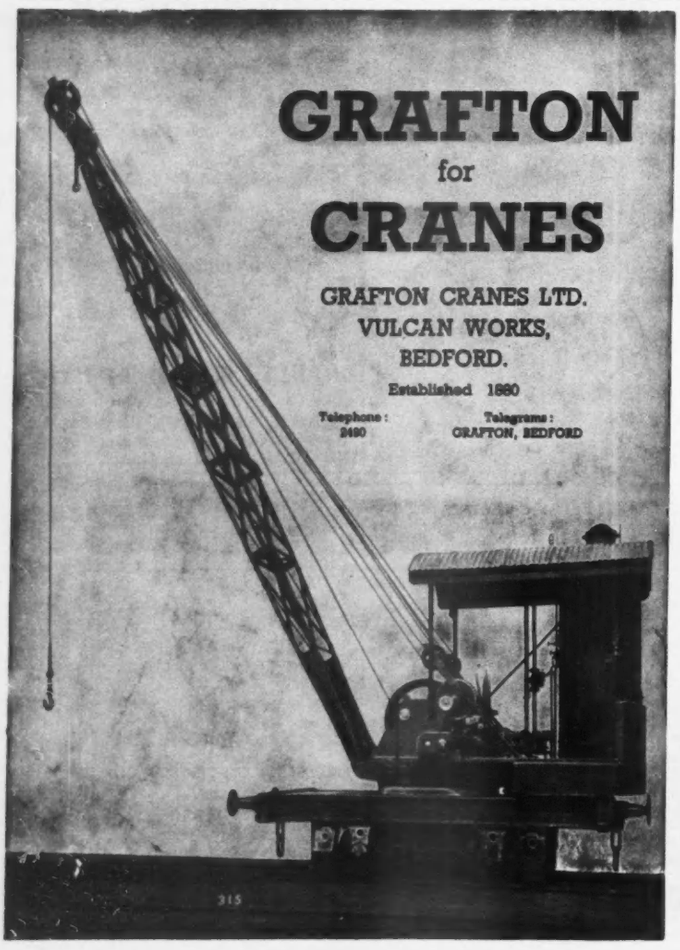

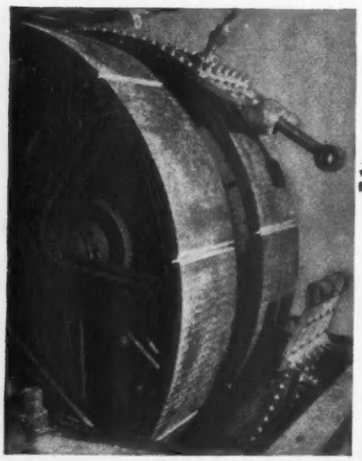

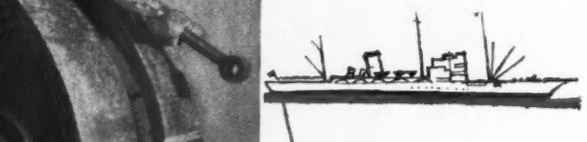

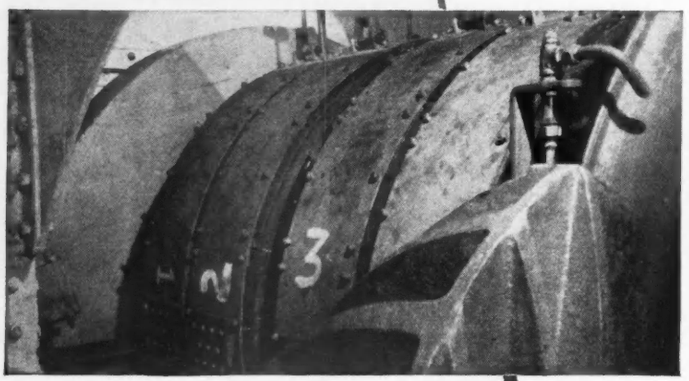

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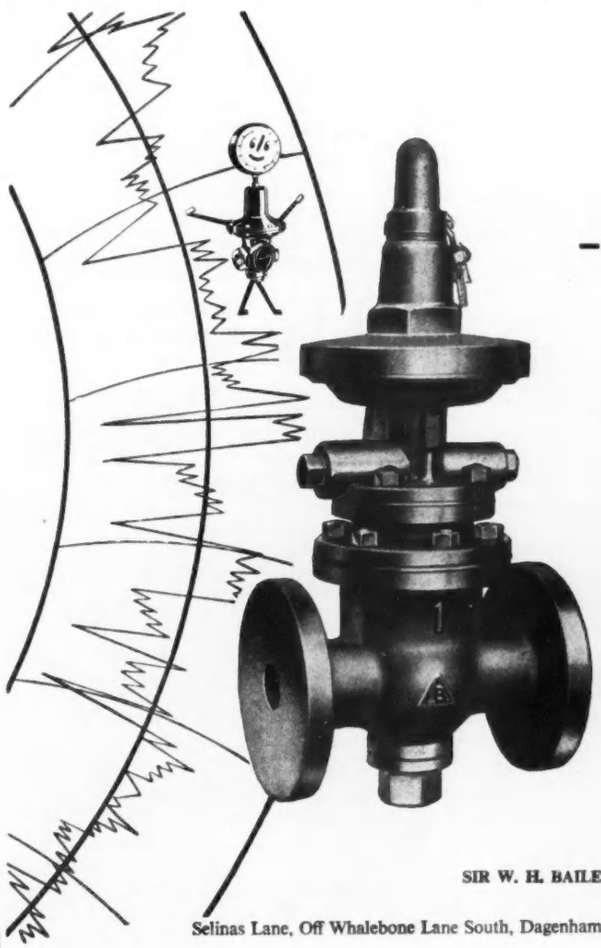

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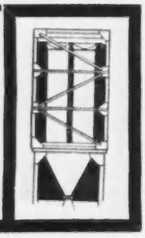

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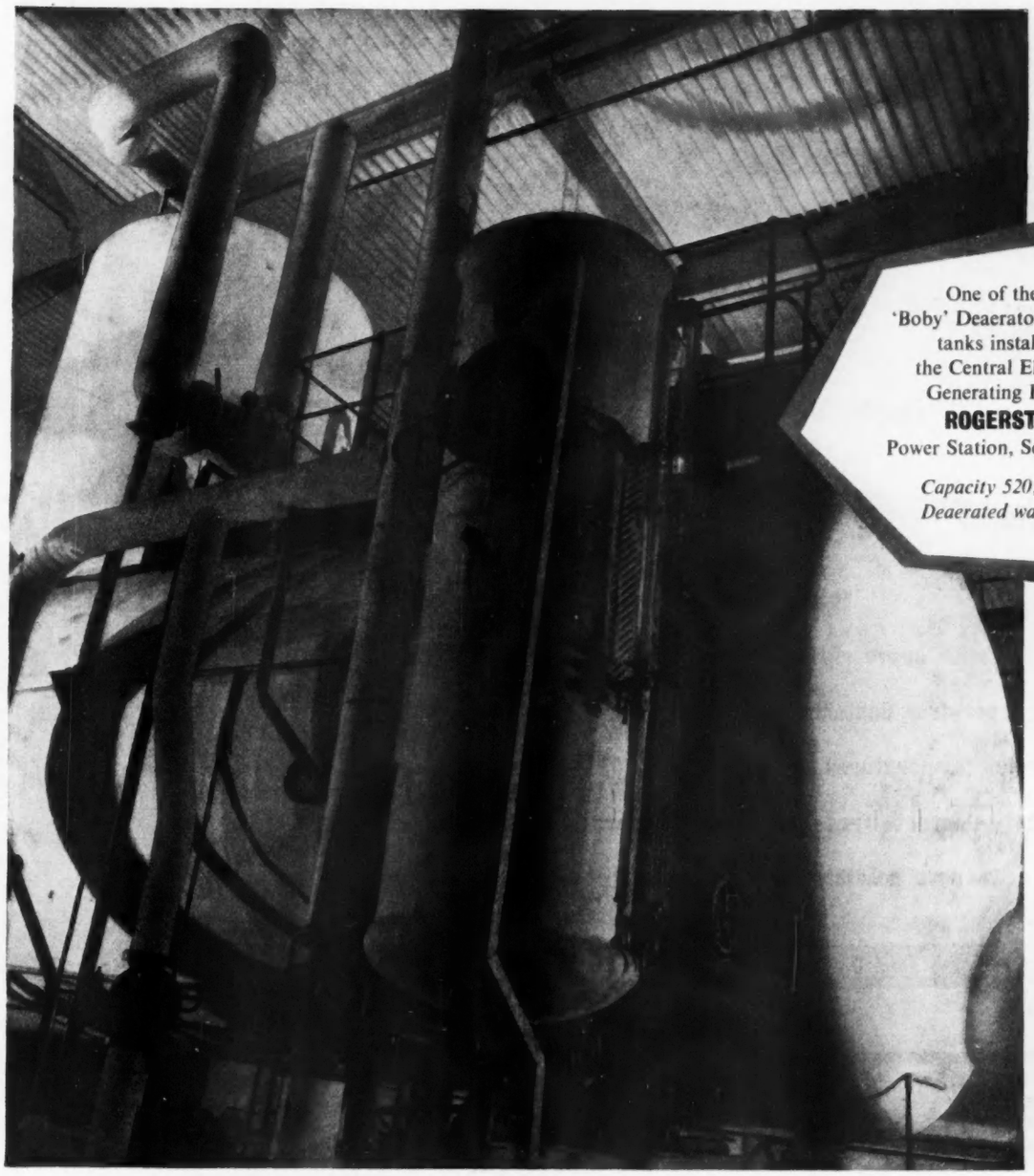

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Top Right: Bottom portion of vessel for sulphuric acid. Weight 7,400 lb.

Below: Cooler shell. Weight 1,900 lb.

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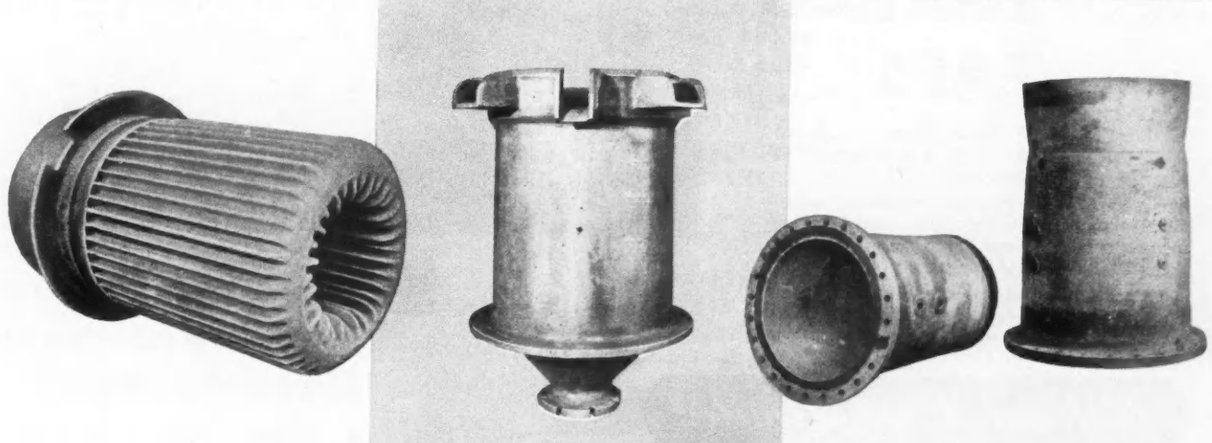

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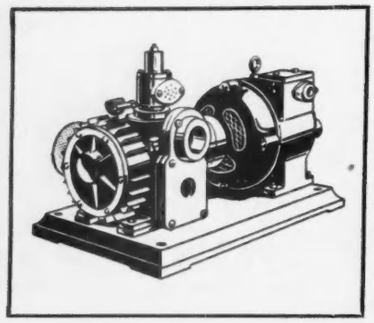

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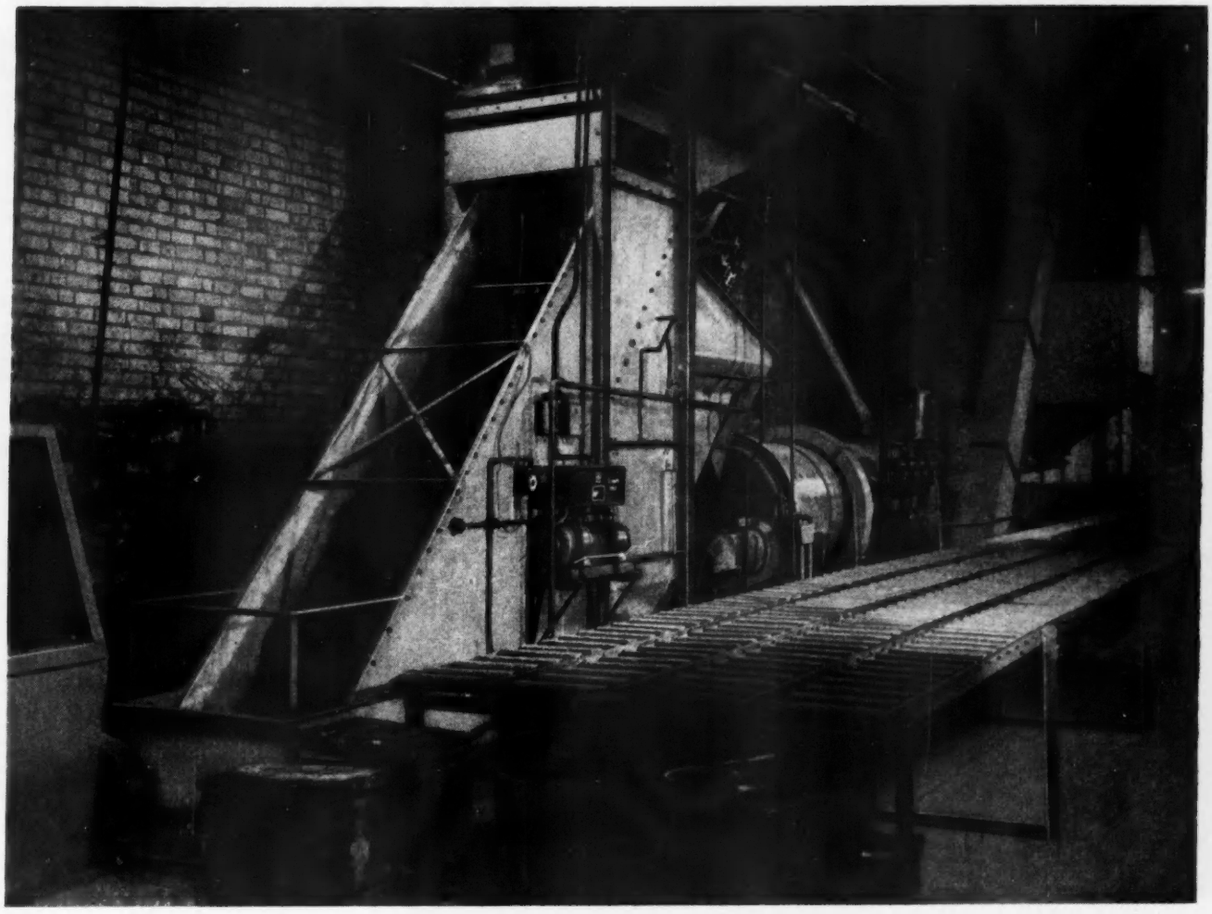

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FOR ALL PURPOSES

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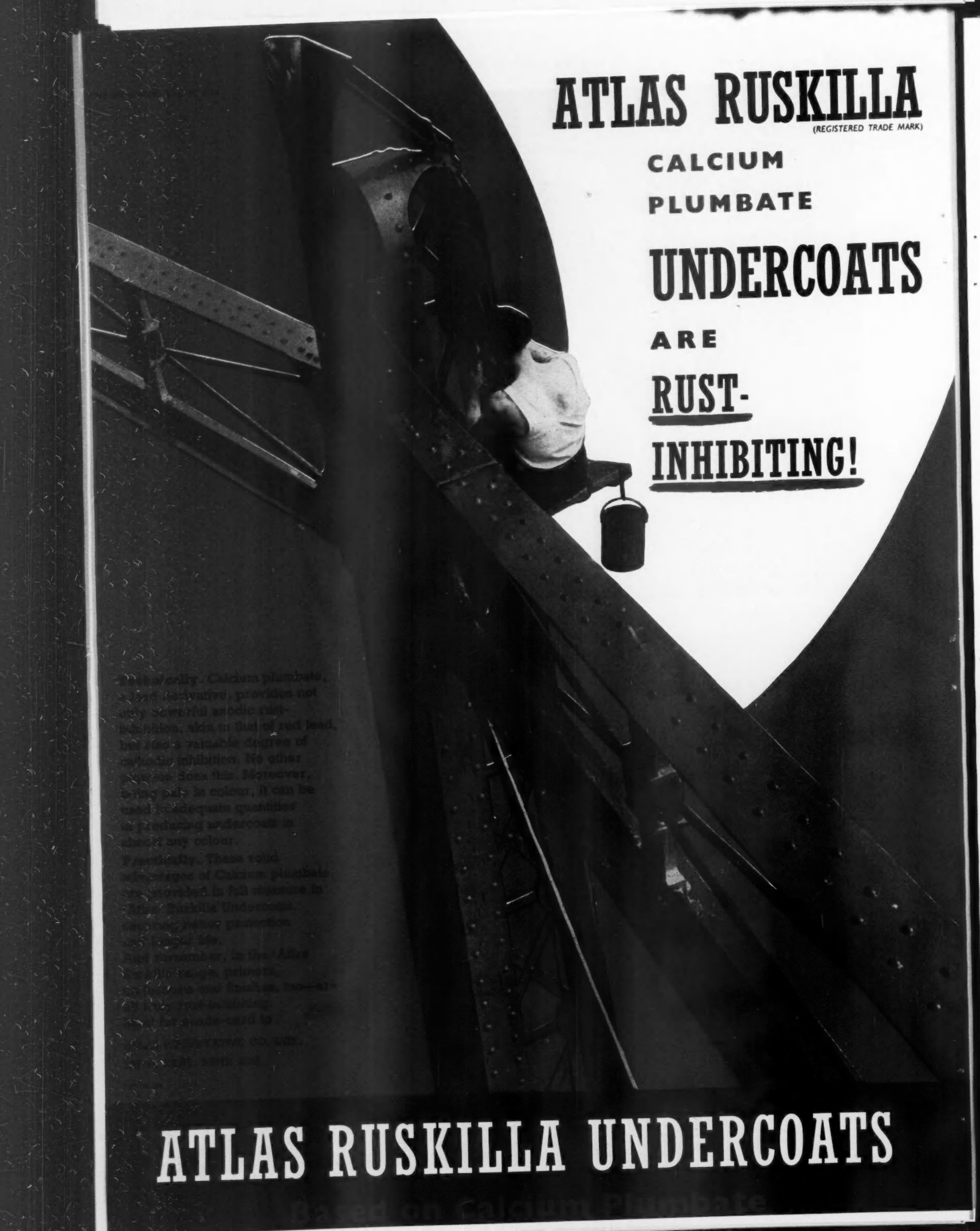
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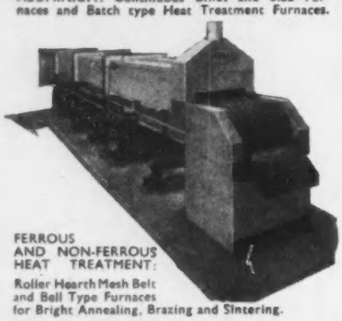

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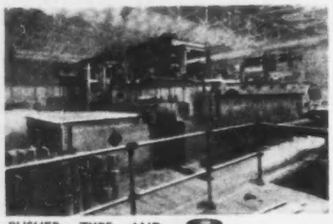

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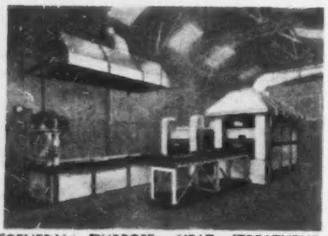

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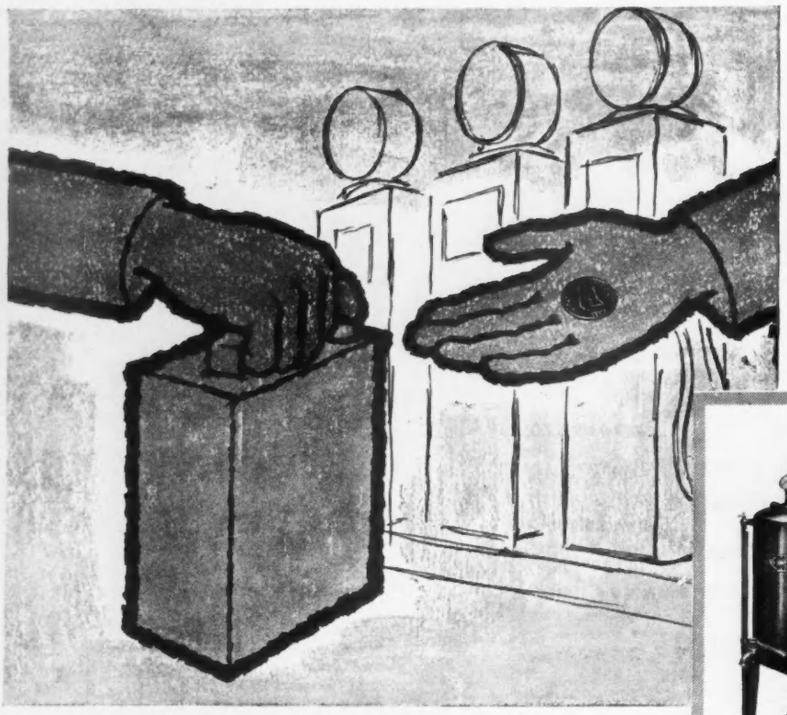

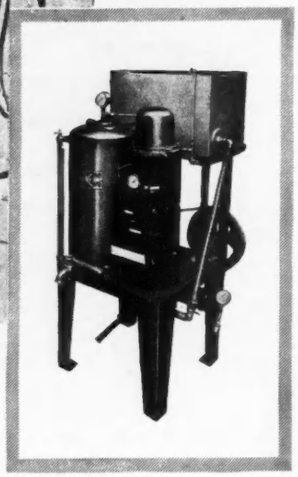

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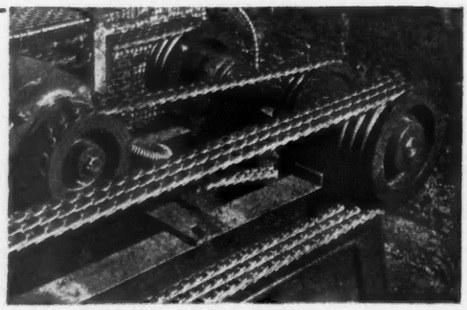

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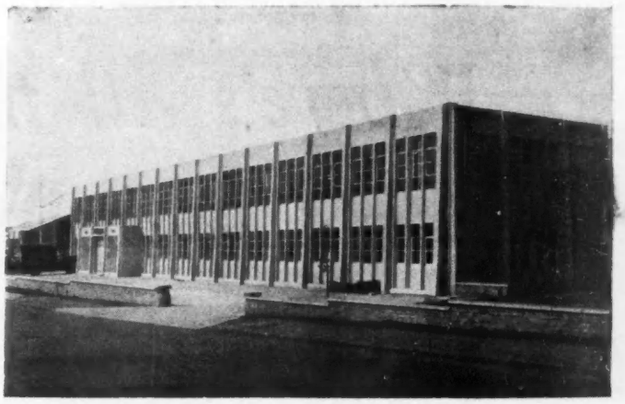
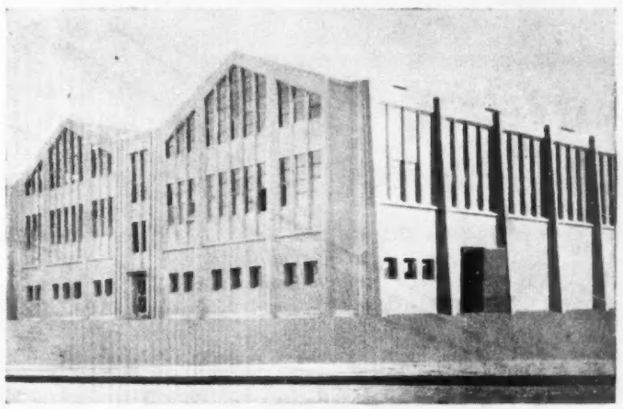


Office block for Messrs. Nortons-Tividale Ltd. Tipton, Staffs.

Interior: Central Engineering Workshop, Messrs. Bryant & May Ltd.
Central Engineering Works, Old Ford Road, Bow, London, E.3.



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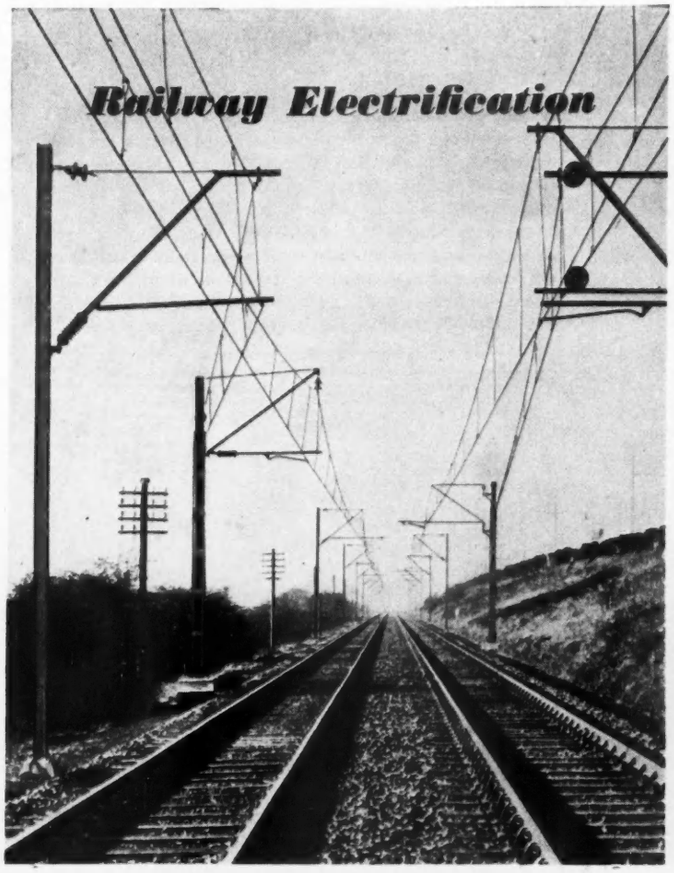

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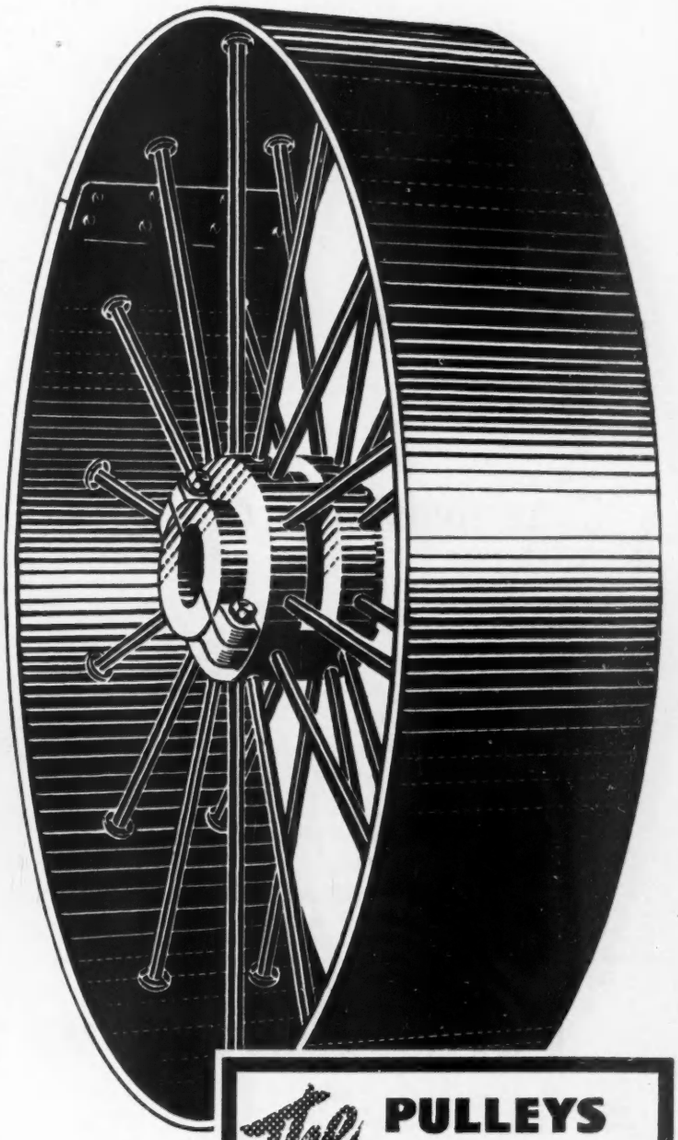

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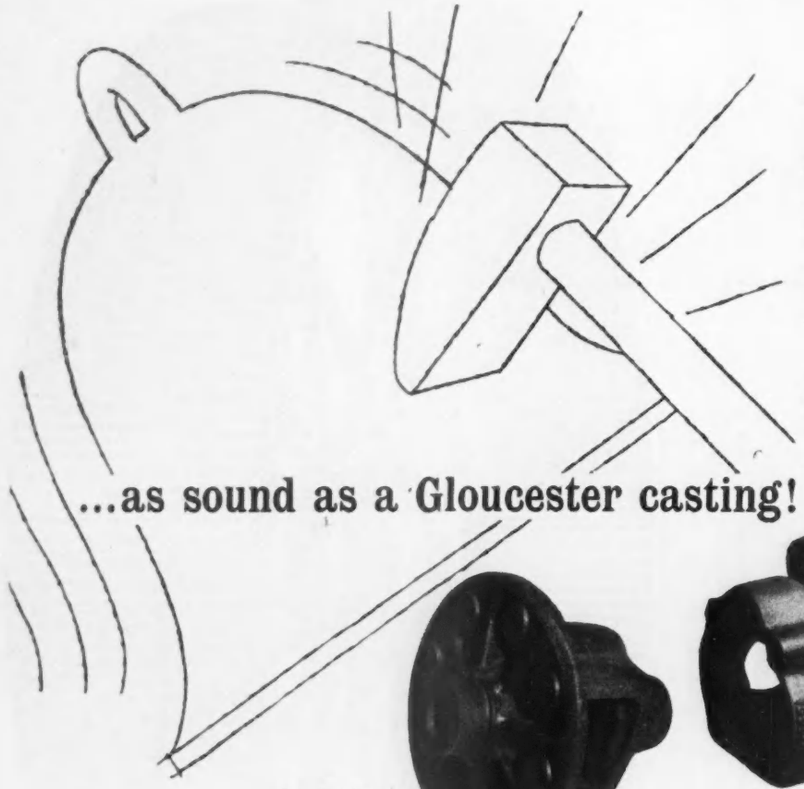

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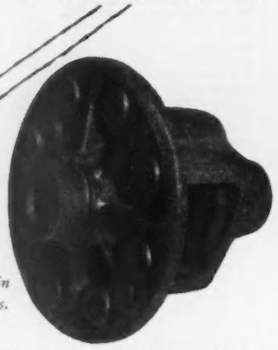
Yield Point	12 tons	Yield Point	24 tons
Tensile Strength	25 tons psi	Tensile Strength	35 tons psi



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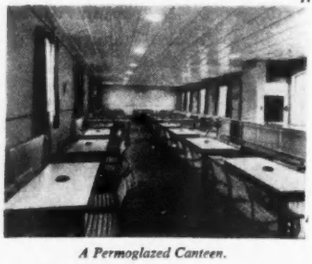

A Permoglazed Canteen.

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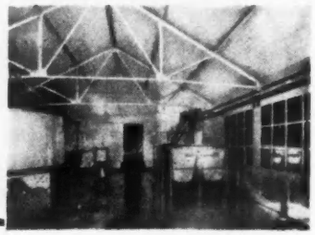

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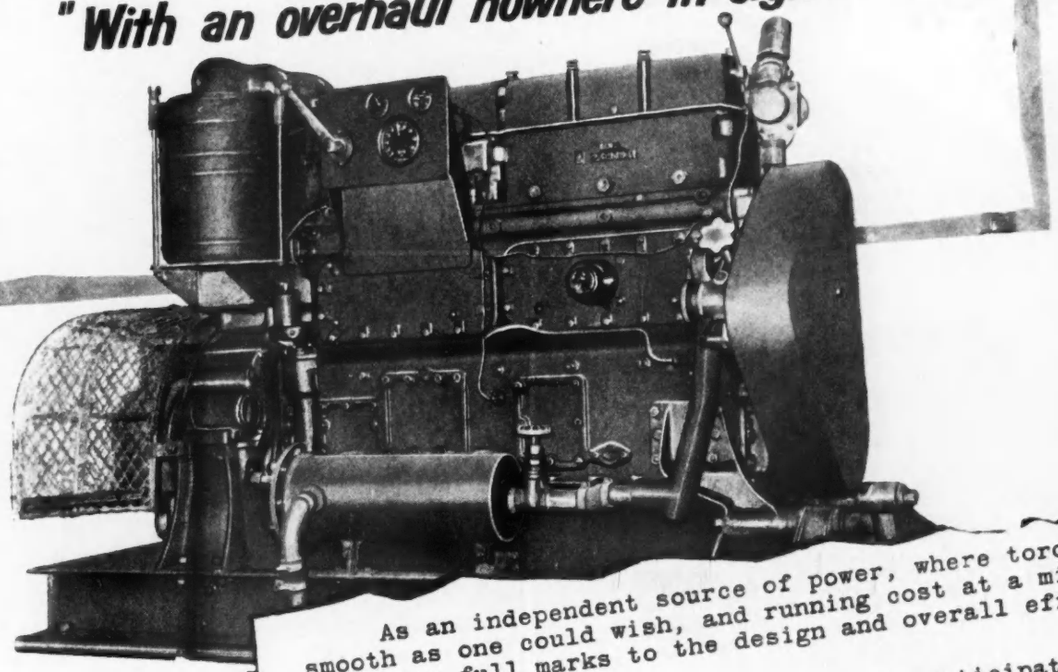

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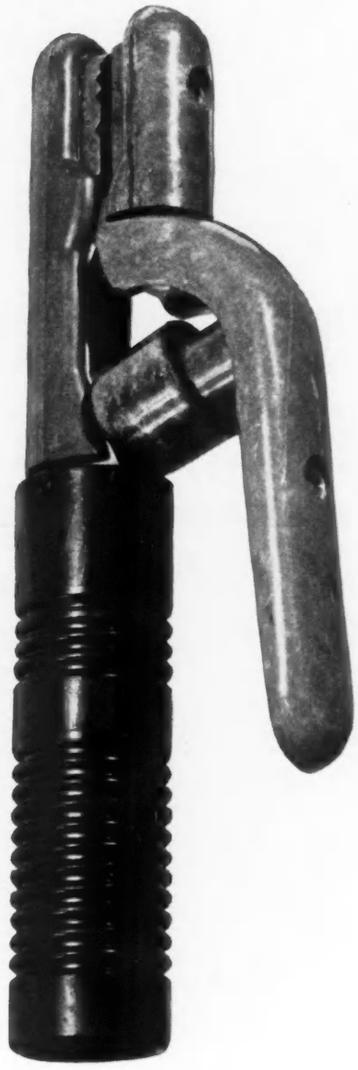

The Lincoln-Jackson A-W Electrode Holder weighs 14 oz. and is 9¾" long; it will handle a ¼" electrode, and operates up to and including 300 amperes.

The new Lincoln-Jackson electrode holders—A-W and JH-2—the result of careful research and design coupled with wide experience in the modern welding field, are now available to all welders in the United Kingdom.

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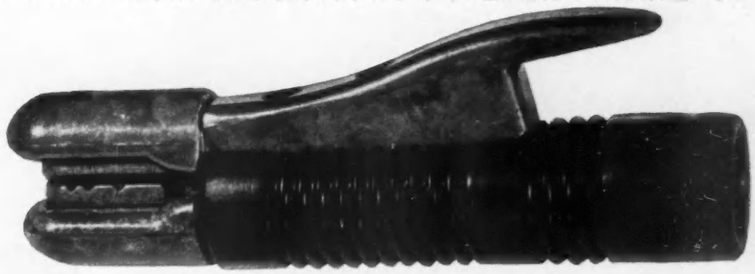
The Lincoln-Jackson JH-2 Electrode Holder weighs 9½ oz. and is 8" long; it will handle a 5/32" electrode, and operates up to approximately 200 amperes.



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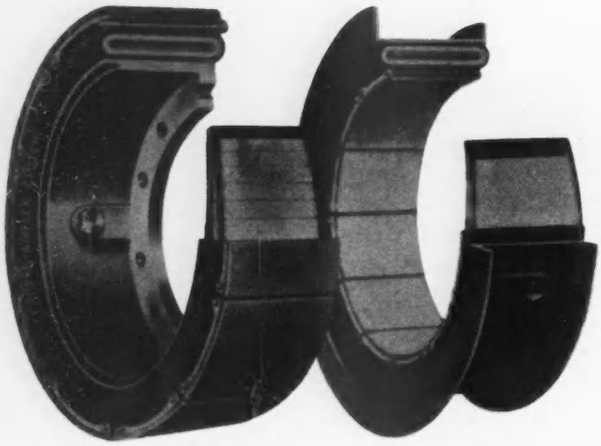

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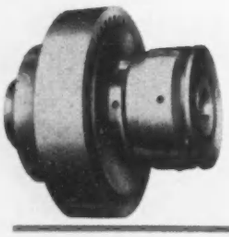
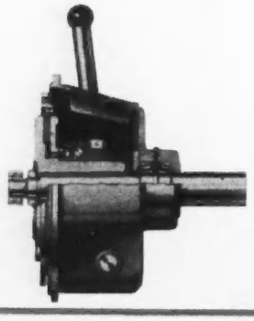


Patent RO Disc Clutch
Publication 5740



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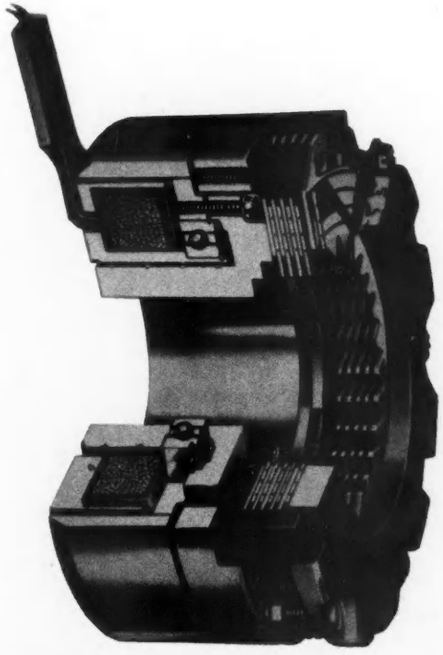

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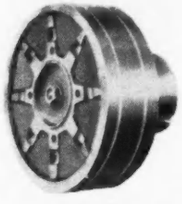
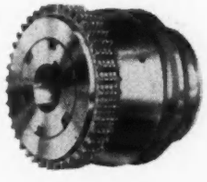
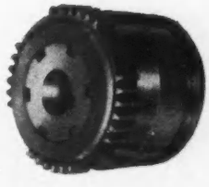


Automatic Centrifugal Clutch
Publication 5722



BOM-L Multiple Disc Clutch
Publication 855



Patent RM Multiple Disc Clutch
Publication 5613

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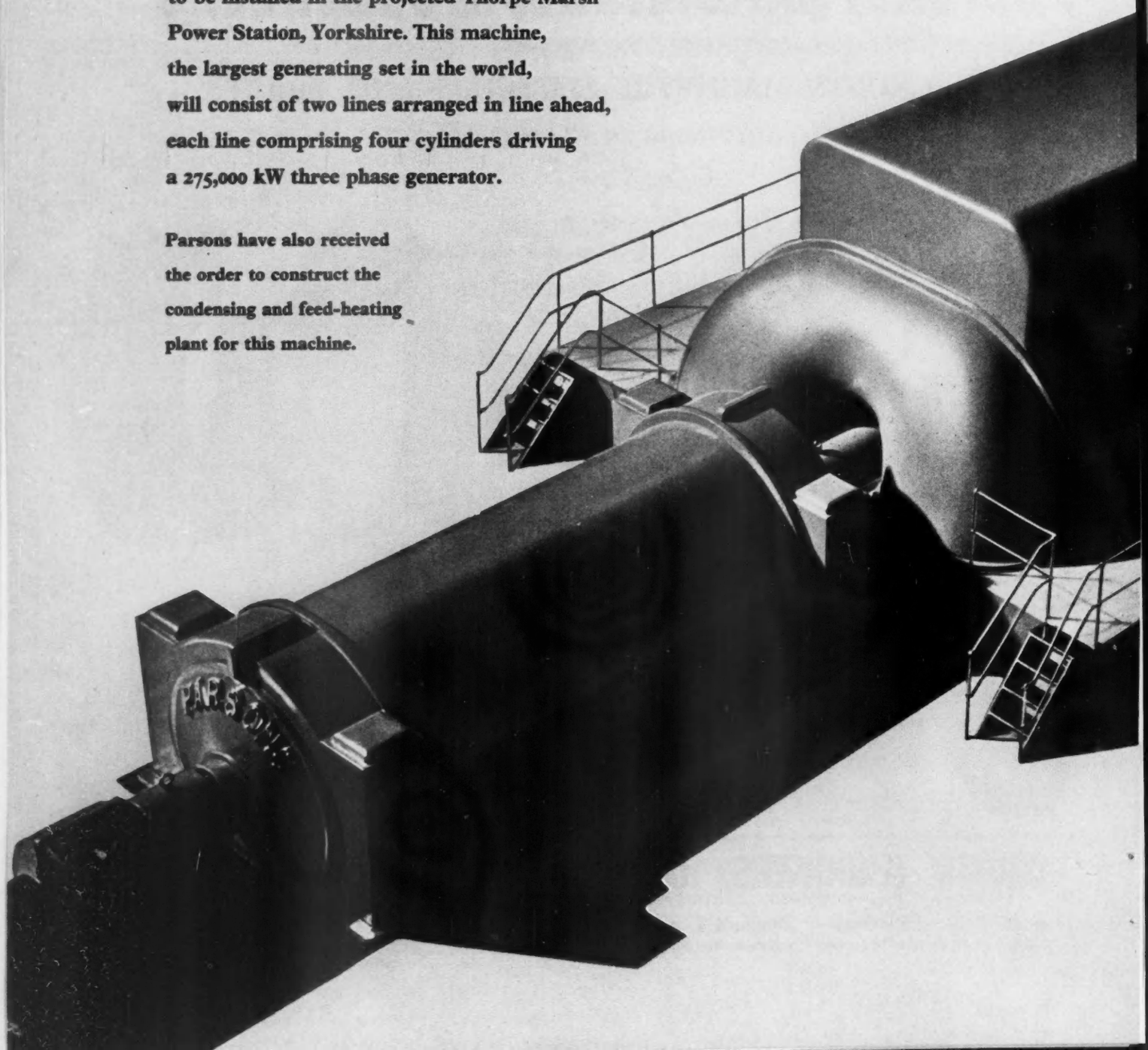
THE CENTRAL ELECTRICITY Generating Board have ordered a PARSONS 550,000 kW turbo-generator to be installed in the projected Thorpe Marsh Power Station, Yorkshire. This machine, the largest generating set in the world, will consist of two lines arranged in line ahead, each line comprising four cylinders driving a 275,000 kW three phase generator.

Parsons have also received the order to construct the condensing and feed-heating plant for this machine.



Steam conditions:—

Pressure:	2,300 lb/in²
Temperature:	1,050° F
Reheat:	1,050° F
Exhaust Vac:	28·7 in. Hg.

All eight main cylinders will be of the double flow type with high pressure cylinder on "A" line taking the 550 MW steam flow. Exhaust steam from this cylinder will be reheated and passed to the first intermediate pressure cylinder on "B" line. Thereafter the steam divides equally between duplicate second intermediate pressure cylinders, one on each line. Final expansion of the steam being through two low pressure cylinders on each line.

Each generator will operate at 18,000 volts ·85 P.F.: 50 cycles per second at 3,000 r.p.m. Stators will be hydrogen cooled with direct water cooled windings. The rotors will be direct cooled.

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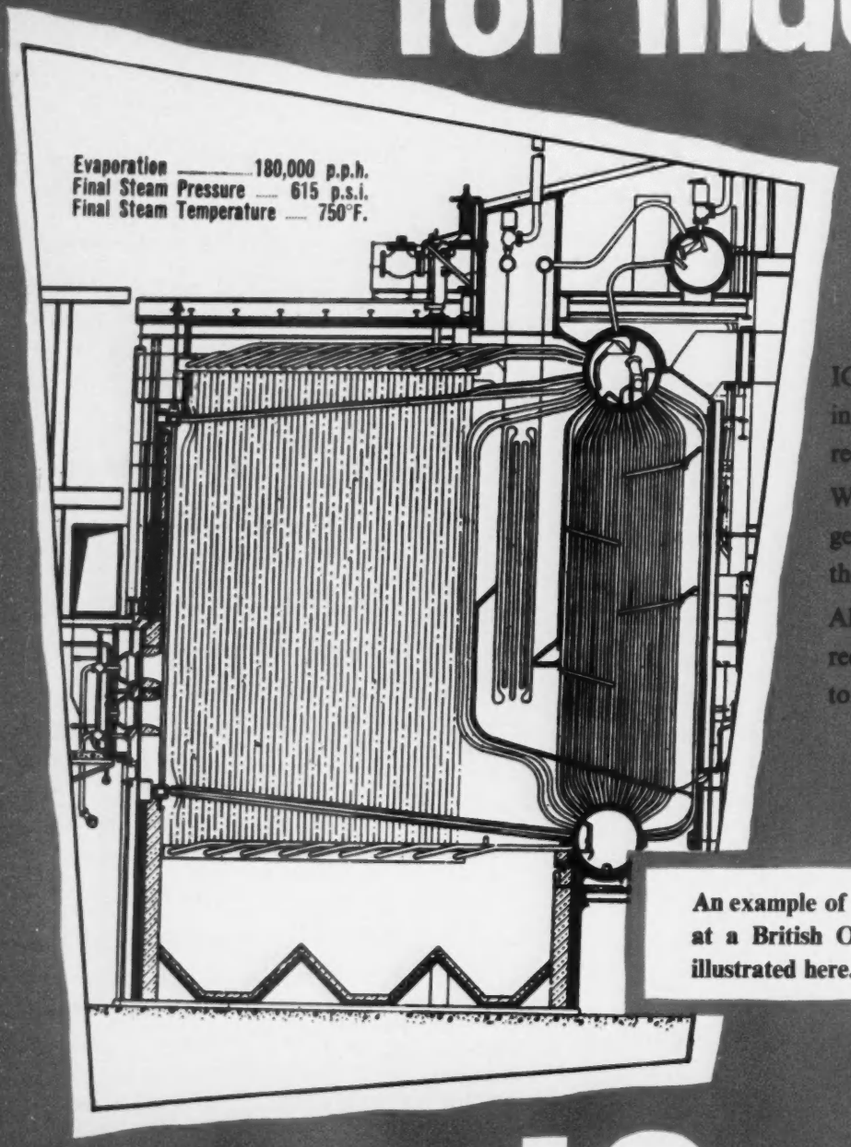

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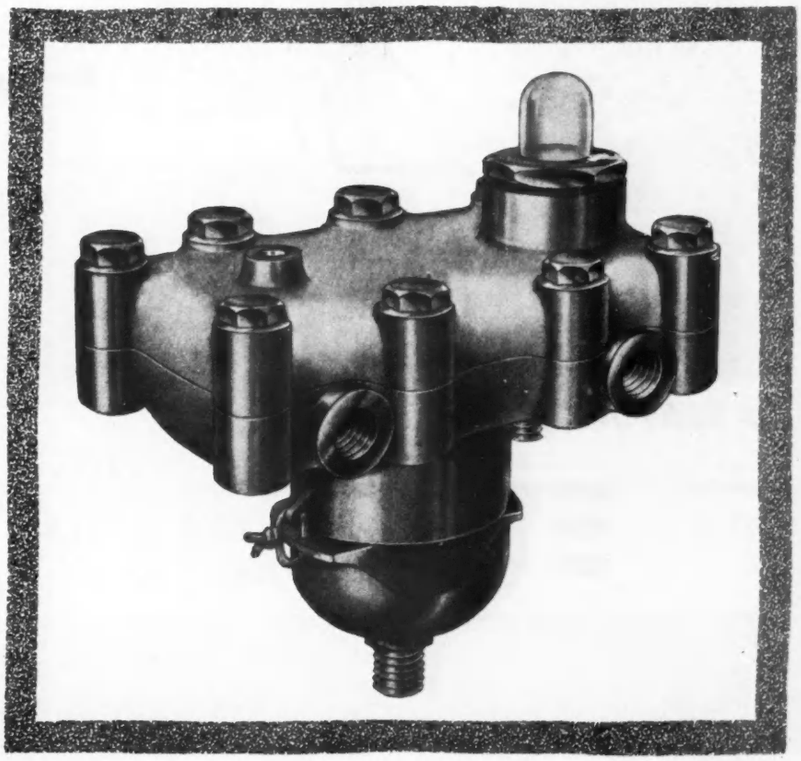

Easily fitted to existing filters, the Vokes Filter Servicing Indicator is an inexpensive, mechanically operated unit. Fitted by copper tubing to the inlet and outlet sides of the filter, it clearly indicates when the filter element is approaching the recommended maximum differential pressure through the collection of contaminants. It can be adjusted and pre-set to operate over a wide range of filter differential pressures and is normally pre-set at the works to suit the application required. Full details of this new Vokes product will gladly be sent on request.

OPERATION

The outer case incorporates a diaphragm dividing the case into high and low pressure compartments, each compartment being connected to the appropriate pressure side of the filter via capillary tubing. Any difference in pressure, and subsequent movement of the diaphragm, applies pressure to an overcentre snap-action spring giving magnified movement at one end. This actuates a vividly coloured thimble, which enters a transparent dome, and is immediately seen externally.

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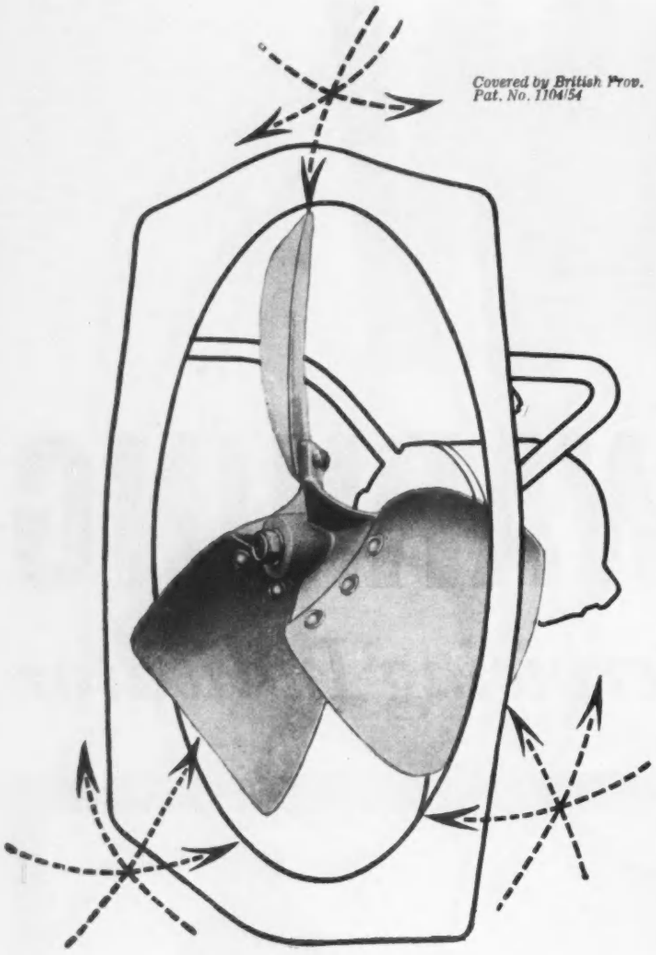

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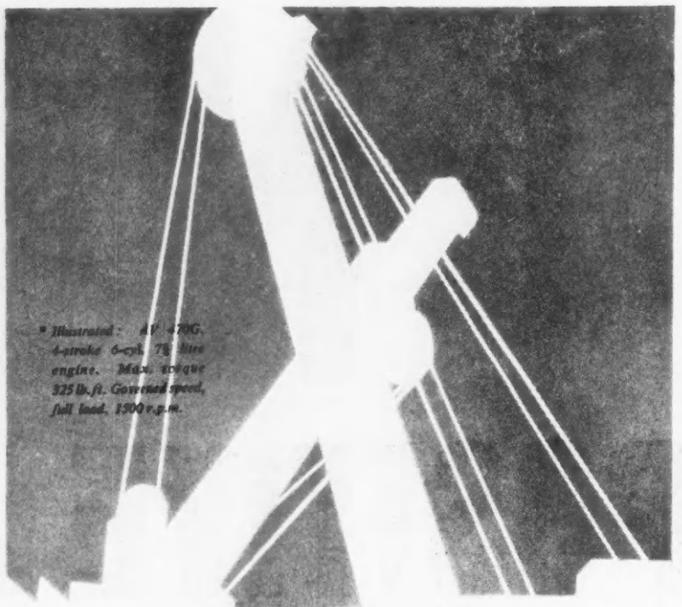

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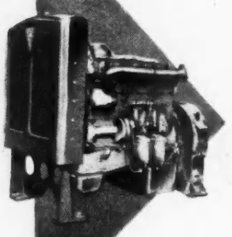

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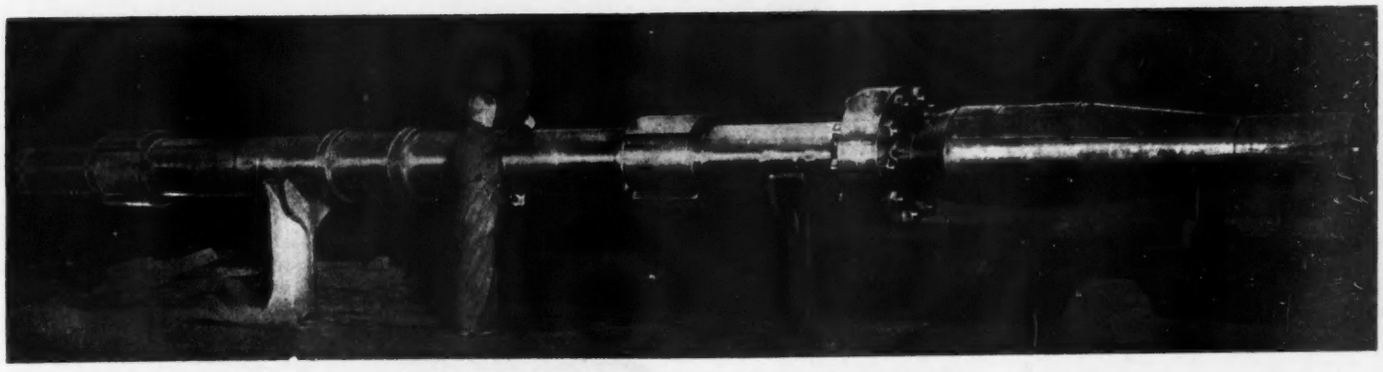

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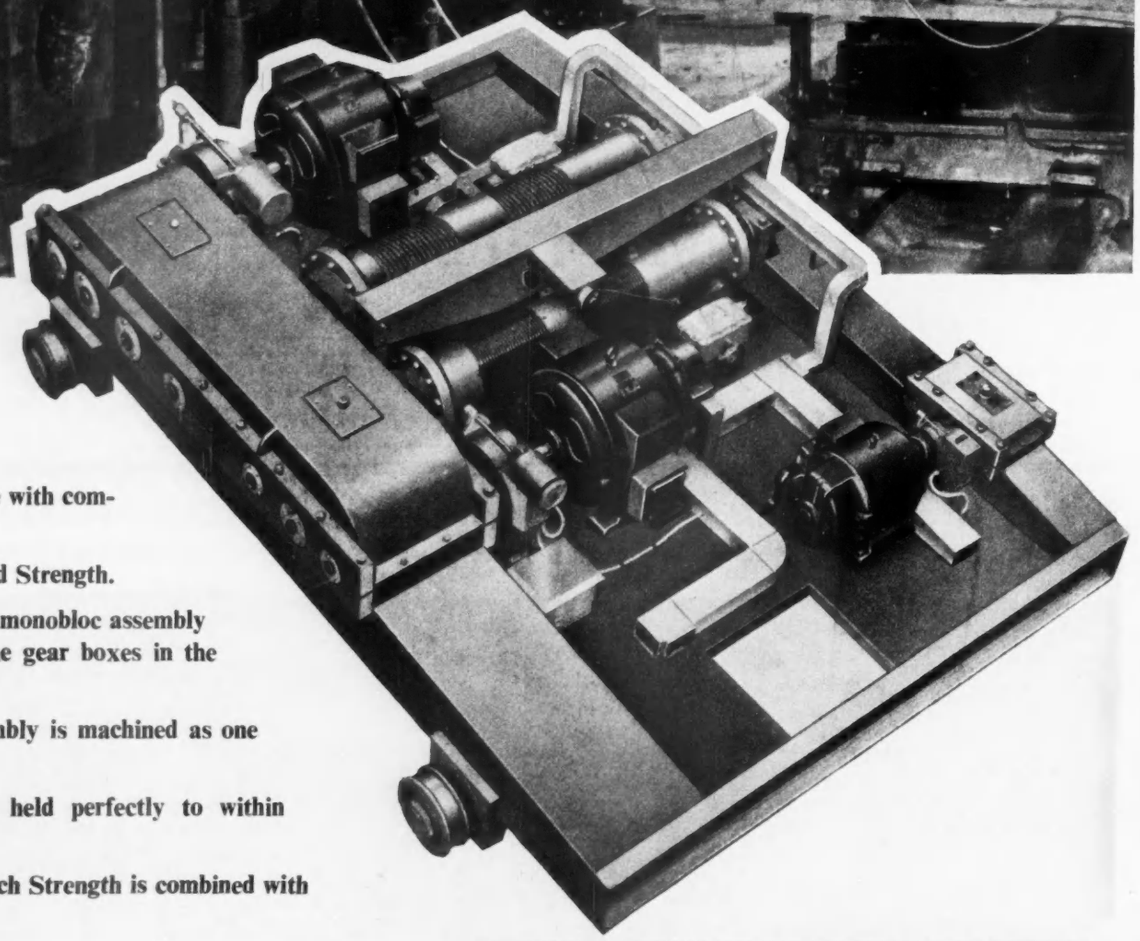

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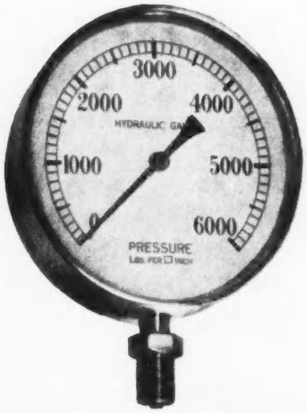

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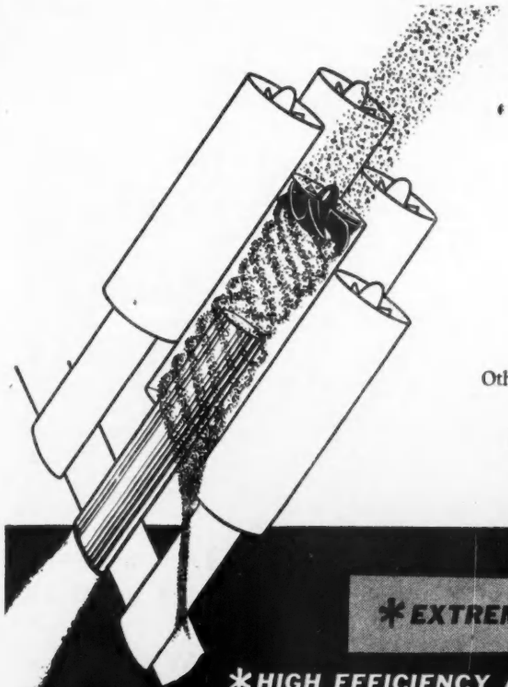

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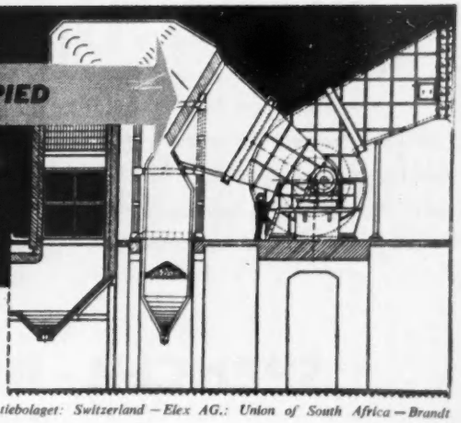

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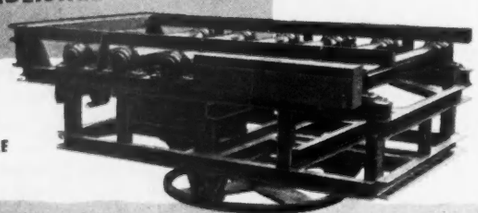

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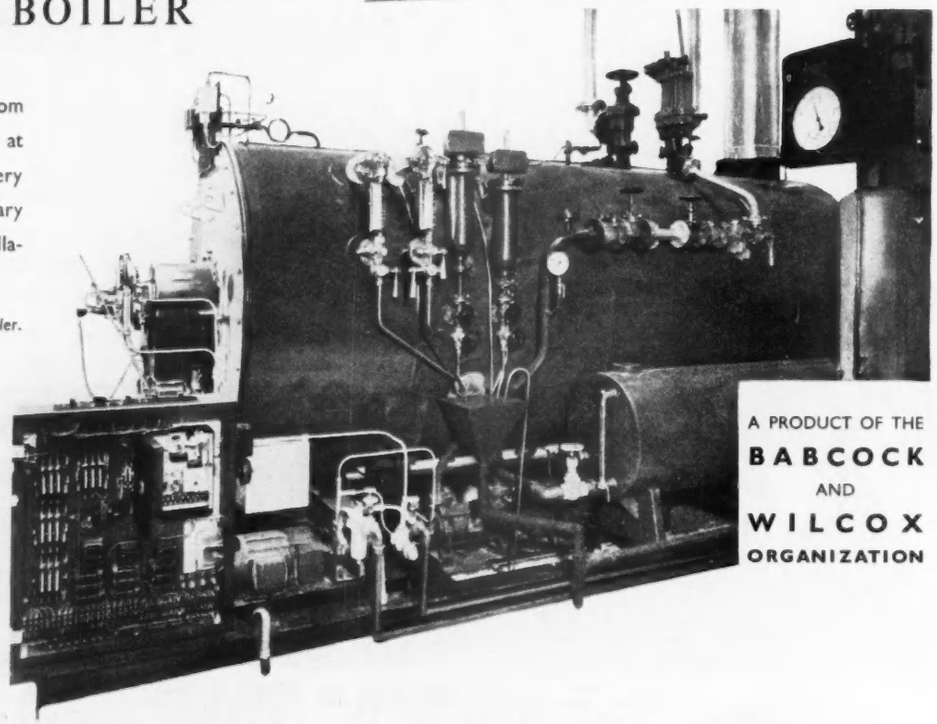

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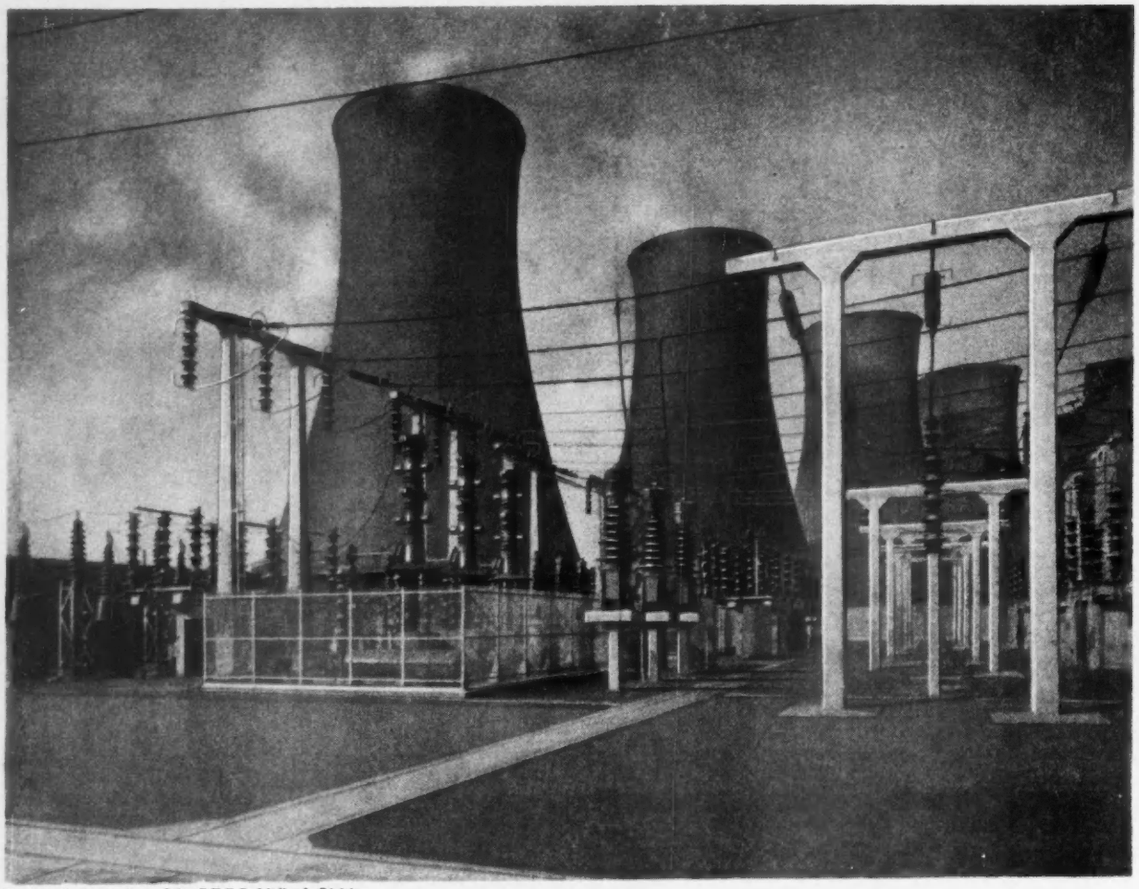

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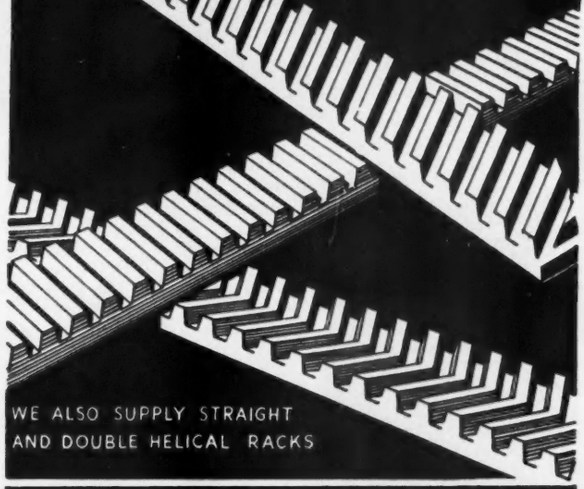

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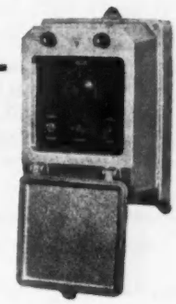

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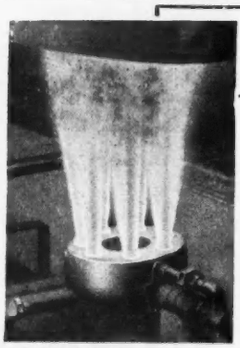

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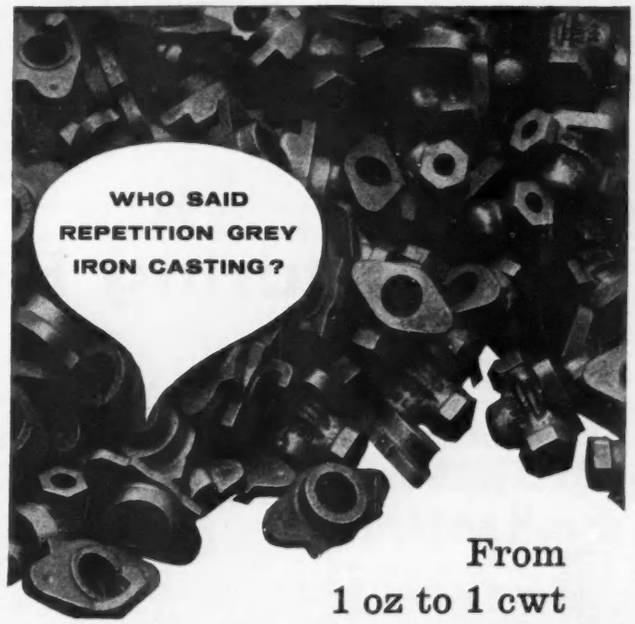

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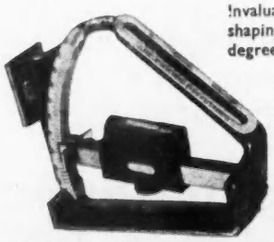

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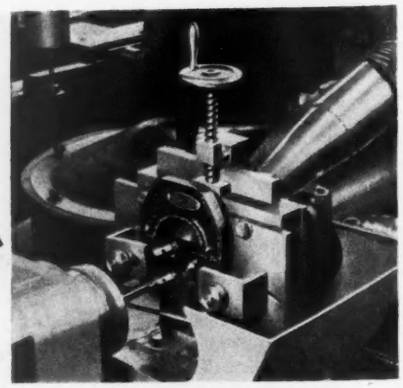
The Caliper is normally supplied as a 'GO' and 'NOT GO' combination gauge so that both tests can be applied in one action, but is also available as 'GO' only or 'NOT GO' only.



A precision co-ordinate frame boring machine for ensuring parallelism and centre distance of anvil mountings.

Adjusting screws, protected by cover plates allow for a wide range of work diameters and tolerances. The gauge, after long usage, can also be re-adjusted many times to size so that the necessity for regrinding is eliminated.

Featuring Horstmann gauges

The Horstmann Model 52 Screw Caliper Gauge puts accuracy in your hands. In addition to the features displayed above, it incorporates many other advantages, all of which contribute to fine accuracy, versatility, long life and ease of handling. The anvils are set so that they do not roll—all shearing action is eliminated—the caliper is suitable for either left- or right-hand threads—and it is ideal for gauging Acme forms and shouldered work. Model 52 is available in a full range of B.A., American, Unified, Whitworth, and Metric forms of thread.

Horstmann also make screw or plain Plug and Ring type gauges. All these precision instruments are guaranteed for accuracy, hardness and finish to the requirements laid down by the National Physical Laboratory.

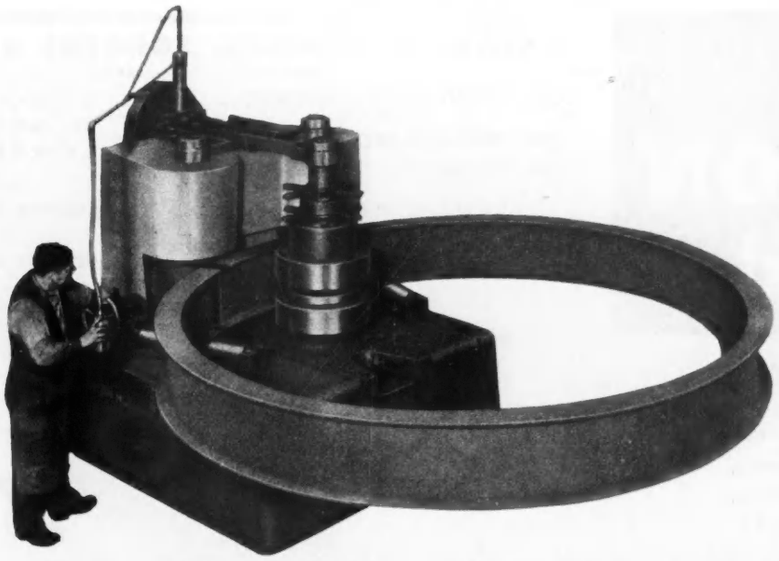
May we send you descriptive leaflets?

HORSTMANN

PLUG, RING & CALIPER GAUGES

THE HORSTMANN GEAR COMPANY LIMITED
NEWBRIDGE WORKS · BATH · ENGLAND · Tel: 7241

SCOTTISH machine tool corporation limited



craig & donald section ring curvers

In a range of five sizes covering virtually every need, the largest will curve a 6 in. by 6 in. by $\frac{7}{8}$ in. angle to 70 in. radius, with horizontal flange to the outside, or with the flange inside, 5 in. by 5 in. by $\frac{7}{8}$ in. angle to 94 in. radius. Channels, joists, flats, etc., may also be rolled.

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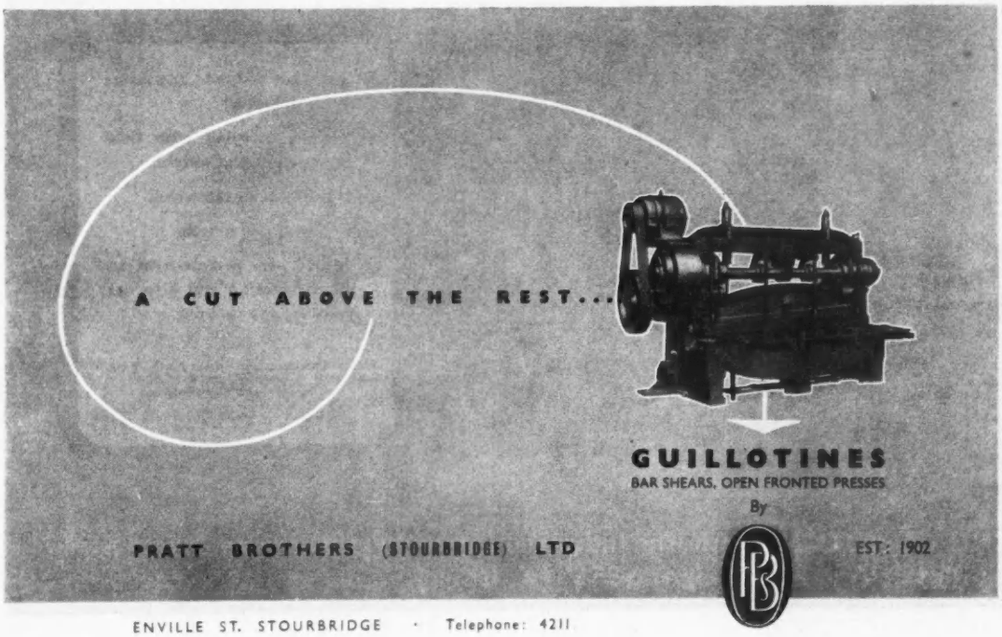
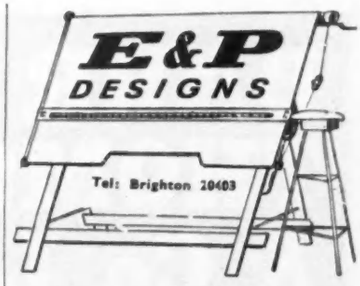
58 Victoria Street, LONDON, S.W.1. *Victoria* 2106
2 Sir Harry's Road, Edgbaston, BIRMINGHAM, 5. *Calthorpe* 2541
The Building Centre, Brunswick Terrace, LEEDS, 2. *Leeds* 25250

SMT



ENVILLE ST. STOURBRIDGE · Telephone: 4211



The service to complement your drawing office.

27 CLARENCE SQUARE,
BRIGHTON

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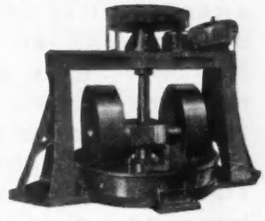
PAN GRINDING MILLS



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PERFORATED OR SOLID BOTTOMS
OVER OR UNDER DRIVEN

Smedley Brothers. Ltd.
Belper. Derbyshire.
Telephone: Belper 12

GREY IRON
CASTINGS

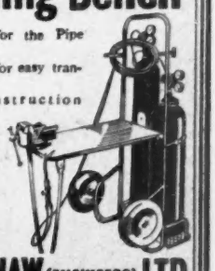
All classes of castings from Medium and Low Phosphorus to High Duty Iron suitable for the Engineering, Motor, Agricultural Implement and Machine Trades.

From ozs. to tons.
Repetition or Loose Pattern.
Fully Equipped Pattern Shop.

SAMUEL SMITH & SONS Ltd.
BEEHIVE FOUNDRY
SMETHWICK, 41, Staffs.

The CROFTSHAW Welding Bench

- Essential for the Pipe fitter.
- Folds up for easy transit on site.
- Steel construction throughout.
- Saves erection and installation time by 30%
- PRICE £24
- Trolley without bench etc. £12 10s.



CROFTSHAW (ENGINEERS) LTD
ORDNANCE ROAD, ENFIELD LOCK, MIDDX. Telephone: Waltham Cross 4709
Site welding and erection specialists—all forms of contract work undertaken.

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GENERAL ENGINEERS, FORGERS & PRESSERS

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KILMARNOCK, SCOTLAND
Grams and Cablegrams:
"BARR KILMARNOCK"
Telephone: KILMARNOCK 791

LONDON OFFICE—
10, NORFOLK ST.,
LONDON, W.C.2
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TUBENPIPE, PHONE, LONDON
Telephone:
COVENT GARDEN 0315/6/7

We Manufacture

DISHED AND FLANGED DRUM ENDS.
FLAT AND FLANGED TANK ENDS.
FLANGED COMPENSATING PLATES.
FLAT COMPENSATING RINGS.
EMBOSSED MANHOLE DOORS.
SINGLE FLANGED NOZZLES.
DOUBLE FLANGED STANDPIPES.
PIPE LINE FITTINGS INCLUDING BENDS, TEES, CROSSES, REDUCERS, CAPS, SADDLES AND SLEEVES.
PIPE LINE FLANGES, SLIP-ON WELDING NECK AND BLANK.
MISCELLANEOUS PRESSINGS AND FORGINGS.

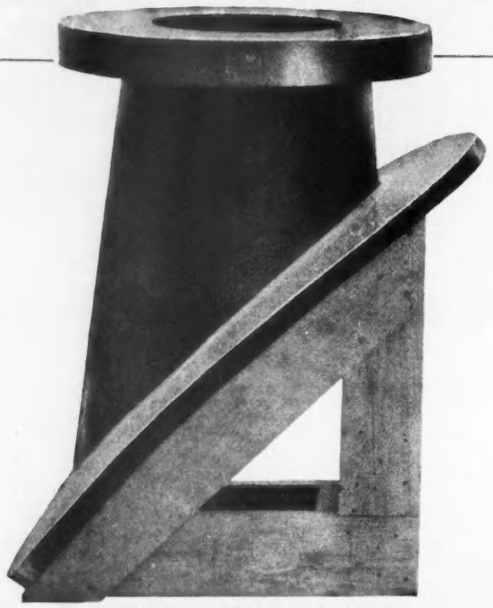


Illustration of 8" dia. bore Solid Forged Bevel Standpipe, for offset position on boiler.

STANWELD

OPEN STEEL FLOORING · STAIR TREADS & HAND-RAIL STANDARDS

- Every bar welded . . no rivets to work loose.
- Weight carrying with minimum depth and weight.
- Non-slip serrated tread.
- Any width or length.
- Spaced bars permit light and air circulation and also easy painting and cleaning.

With acknowledgements to the North Western Gas Board to whom we are indebted for the privilege of taking this photograph.

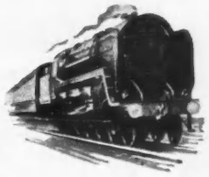
STANWELD ENGINEERING CO. LTD. Roundthorne Industrial Estate, Wythenshawe, Manchester 23
Tel: Wythenshawe 5555 (4 lines)

TUBE EXPANDERS

FOR ALL PURPOSES.

As supplied to the Admiralty, British Electrical Authority, Railways, Oil Refineries, leading Boiler Makers and industrial users.

LEADING TUBE EXPANDER MANUFACTURERS FOR OVER 70 YEARS



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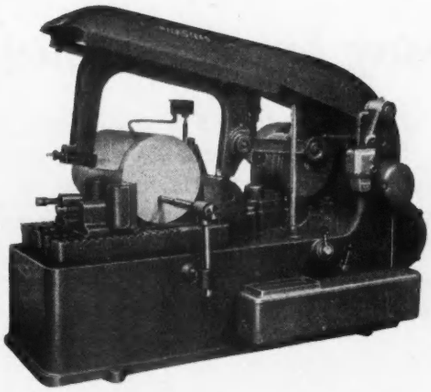
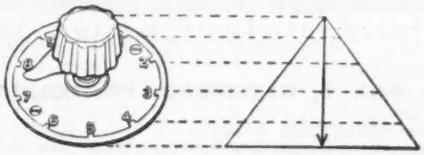
FOR ALL INDUSTRIES, ALL COUNTRIES.



YOU INCREASE THE PRESSURE TO SUIT THE SECTION



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SAWING MACHINES

Unique in design. Proved in practice. One simple setting and it's capable of dealing with any section within its range with blades of one pitch of tooth. The blade commences and finishes each cutting stroke with no pressure whatsoever. What a saving in blades!

FAMOUS FOR SPEED ACCURACY AND RELIABILITY

CHARLES WICKSTEED & CO (1920) LTD. **KETTERING. Tel: Kettering 3113**

Building for every industry

Whether the output is to be Kiddie Kars or Kilowatts—the location Kilmarnock or Kittimac, if the building is to be in steel Wright Anderson will see the job through from inception to completion. Our reputation has been built within the solid framework of dependability and meticulous attention to detail on a firm foundation of world wide experience.

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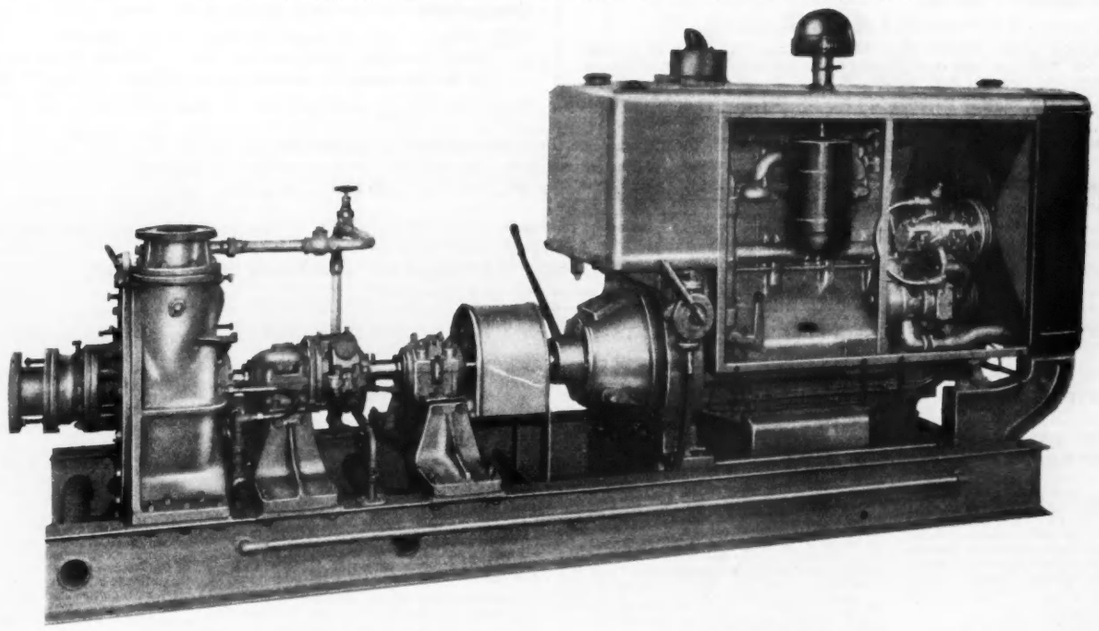
London Office: Regent House, Kingsway, W.C.2. Tel: HOLborn 9811

CONTRACTORS TO H.M. GOVERNMENT, CENTRAL ELECTRICITY AUTHORITY, NATIONAL COAL BOARD, ATOMIC ENERGY AUTHORITY AND CROWN AGENTS FOR OVERSEAS GOVERNMENTS AND ADMINISTRATIONS

P 4598

GRAVEL PUMPS



4½/5" Centrifugal Sand and Gravel Pump with Diesel Engine Drive.

EASTON & JOHNSON LTD. · TAUNTON, ENGLAND

TELEPHONE 3146 GRAMS: EASTWALD, TAUNTON

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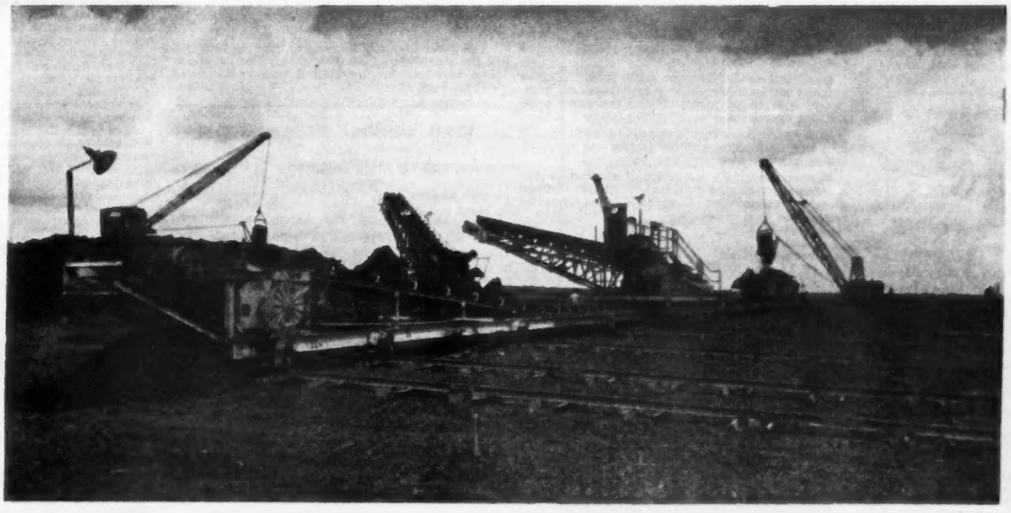
ON THE GREAT OUSE FLOOD PROTECTION SCHEME



Photograph reproduced by permission of Sir Robert McAlpine & Sons (Midlands) Limited.

This 42" wide belt conveyor scheme 400 feet long handles 600 tons per hour of spoil from the 200ft. wide relief channel being cut near King's Lynn. The equipment is specially designed for high mobility to enable almost continuous excavation to be carried out.

RICHARD SUTCLIFFE LIMITED · HORBURY WAKEFIELD ENGLAND

CLASSIFIED ADVERTISEMENTS

AGENCIES · DIRECTORS · PARTNERSHIPS · SITUATIONS VACANT · EDUCATIONAL PATENTS · BUSINESS OPPORTUNITIES · MISCELLANEOUS · PUBLIC APPOINTMENTS BUSINESSES and PREMISES · TENDERS

Lineage Rate. 4/- per line of approximately 6 words. Minimum 16/-.

Inch Rate. 48/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £25 10s. ½-page £48. Full page £90.

AUCTION SALES · FOR HIRE · MACHINERY, etc., WANTED · SITUATIONS WANTED DRAWING AND DESIGN SERVICES · FOR SALE · SUB-CONTRACTING

Lineage Rate. 3/6 per line of approximately 6 words. Minimum 14/-.

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Series Discounts. For advertisements 1 inch and upwards. 6 insertions 5%. 13 insertions 10%. 26 insertions 15%.

Run-On and Semi-Displayed Styles. Both these styles are available for single column width advertisements of any depth up to 12 inches.

Displayed and Illustrated Styles. The minimum size for a Displayed advertisement is 3 inches single column, for an illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.

Use of Box Number. 2/-, which includes forwarding of replies.

Copy Dates. "Run-on" and "Semi-displayed" advertisements by noon Tuesday for publication on Friday same week. "Displayed" and "Illustrated" advertisements by noon Friday for publication on following Friday. All advertisements three days earlier if proofs are required.

***Advertisements for publication should be addressed to:*— Classified Advertisement Dept., "The Engineer", 28 Essex Street, Strand, London, W.C.2.**

Urgent advertisements may be telephoned to CENtral 6565.

PUBLIC APPOINTMENTS

UNIVERSITY OF WESTERN AUSTRALIA

SENIOR LECTURER OR LECTURER IN HYDRAULICS

Applications are invited for the position of SENIOR LECTURER or LECTURER IN HYDRAULICS in the Department of Civil Engineering of the University of Western Australia. Preference will be given to applicants who hold an Honours or higher Degree in Engineering and have had experience in applied hydraulic work or in research. Teaching covers all aspects of hydraulics, including fluid mechanics and hydraulic machines. A new hydraulics laboratory is under construction.

The salary range for the Senior Lecturer is £A2150–£A2500, and for the Lecturer, £A1550–£A2050 per annum, with superannuation similar to F.S.S.U. Commencing salary will depend on the qualifications and experience of the successful applicant.

Further particulars and information as to the method of application may be obtained from the Secretary, Association of Universities of the British Commonwealth, 36, Gordon Square, London, W.C.1.

The closing date for the receipt of applications in Australia and London, is 30th June, 1958. E7168

UNIVERSITY OF ADELAIDE

AUSTRALIA

LECTURER

Applications are invited for appointment as LECTURER IN MECHANICAL ENGINEERING (Drawing and Design).

Salary Scale: £A1420–£A90–£A2050; with superannuation on the F.S.S.U. basis.

Copies of the general conditions of appointments of sub-professorial staff in the University of Adelaide and of a statement for the information of candidates may be had on application to the Secretary, Association of Universities of the British Commonwealth, 36, Gordon Square, London, W.C.1. Any further information desired will be supplied on request.

Applications, in duplicate and giving the information listed in the general conditions of appointment, should reach the Registrar, University of Adelaide, Adelaide, South Australia, not later than June 16, 1958. E7151

UNIVERSITY OF MALAYA

LECTURERS

Applications are invited for 2 appointments as (i) LECTURER, or (ii) ASSISTANT LECTURER IN ENGINEERING from graduates with recognised professional qualifications in Civil Engineering. Salary scales: (i) £1148 by £49 to £1442/£1540by £56 to £1820 p.a.; (ii) £1001 by £49 to £1099 p.a. Entry point according to qualifications and experience. Allowances: expatriation in range £280–£308 p.a., cost of living in range £210–£560 p.a. Passages for appointee, wife and children under 12 years. Part-furnished quarters at reasonable rent. Provident fund scheme.

Detailed applications (6 copies), naming three referees, by 15th June, 1958, to Secretary, Inter-University Council for Higher Education Overseas, 29, Woburn Square, London, W.C.1, from whom further particulars may be obtained. E7181

UNIVERSITY OF MELBOURNE

AUSTRALIA

SENIOR LECTURER

Applications are invited for a position of SENIOR LECTURER IN ELECTRICAL ENGINEERING.

Applicants should preferably have had experience in power and general electrical engineering.

The salary range is £A2100 to £A2500 per annum. Initial salary will be determined according to qualifications and experience. Superannuation similar to F.S.S.U. in Great Britain will be provided.

Conditions of appointment may be obtained from the Secretary, Association of Universities of the British Commonwealth, 36, Gordon Square, London, W.C.1.

Applications close, in Australia and London, on 1st July, 1958. E7152

UNIVERSITY OF ABERDEEN AND ROBERT GORDON'S COLLEGES

UNIVERSITY LECTURER IN MECHANICAL ENGINEERING

Applications are invited for the post of UNIVERSITY LECTURER IN MECHANICAL ENGINEERING. Candidates should preferably have qualifications in Applied Thermo-Dynamics. An interest in Heat Transfer apparatus, or in the special problems associated with the generation of Heat and Power from Nuclear Reactors, and some industrial or research experience would be an advantage. There are excellent facilities for research or advanced studies requiring appreciable quantities of steam or compressed air.

The University Regulations permit members of the teaching staff to read for the Degree of Ph.D. by research.

Salary in range rising to £1650, with membership of the F.S.S.U. and children's allowances. Initial Salary according to qualifications and experience. University-owned accommodation becomes available from time to time.

Further information may be obtained from the Secretary, The University, Aberdeen, with whom applications (20 copies), giving names of three referees, should be lodged not later than 6th June, 1958. An applicant outside the British Isles may submit one copy of application. E7174

CANTERBURY EDUCATION AUTHORITY

TECHNICAL COLLEGE

GRADE "B" ASSISTANTS

Applications are invited for the following posts for 1st September:—

(1) GRADE "B" ASSISTANT, to teach Applied Thermodynamics, Strength of Materials and/or Theory of Machines to Higher National Certificate standard.

(2) GRADE "B" ASSISTANT, for general Mechanical Engineering subjects in both National Certificate and Craft courses.

Qualifications for both the above posts: Degree and/or Corporate Membership of Professional Institution, with sound industrial and preferably some teaching experience.

Salary (Burnham Technical Scale): £650 by £25 to £1025, with allowances for Degree and approved industrial experience.

Further particulars and forms of application may be obtained from the Principal, Technical College, Longport, Canterbury. Completed forms should be returned as soon as possible.

N. POLMEAR,
Chief Education Officer.

Education Offices,
78, London Road,
Canterbury,
7th May, 1958. E7175

MIDDLESEX COUNTY COUNCIL EDUCATION COMMITTEE

ENFIELD TECHNICAL COLLEGE, QUEENSWAY, ENFIELD, MIDDLESEX

SENIOR LECTURER

Required for 1st September, 1958:

SENIOR LECTURER in CIVIL ENGINEERING to teach Theory of Structures and Surveying to the standard of the Final Part II Associate Membership Examination of the Institution of Civil Engineers.

Corporate Membership of the Institution of Civil Engineers is essential. Candidates should be University Graduates with appropriate teaching and industrial experience.

Salary in accordance with the Burnham (Technical) Report 1956, i.e. £1350 by £50 to £1550 plus London allowance.

Application forms (stamped addressed foolscap envelope) from the Principal to whom completed forms should be returned within 14 days of the appearance of this advertisement.

C. E. GURR, M.Sc., Ph.D.,
E7157 Secretary to the Education Committee.

ROYAL CORPS OF NAVAL CONSTRUCTORS

SCHOOLS ENTRY

A COMPETITION FOR ENTRY INTO THE ROYAL CORPS OF NAVAL CONSTRUCTORS will be held in July, 1958.

Accepted candidates will be established as Probationers in the R.C.N.C. and will undergo a 2-year course of training at the R.N. Engineering College, Manadon, and in H.M. Dockyard, Devonport, followed by a 3-year course at the R.N. College, Greenwich.

Candidates must be aged between 18 years and 19 years 6 months, inclusive, on 1st September, 1958.

Candidates with the General Certificate of Education will be required to have passed at Advanced Level in at least Pure Mathematics, Applied Mathematics and Physics, and to produce evidence of general education at Ordinary level.

Candidates with the Scottish Leaving Certificate will be required to have higher grade passes in Physics and Mathematics and at least lower grade passes in English and a language other than English and two other subjects (preferably mathematical).

Candidates from schools in Northern Ireland will be required to produce a certificate from the Ministry of Education in Northern Ireland, showing a comparable standard to that above.

The work of the R.C.N.C. covers all aspects of design construction and repair of H.M. Ships. Members undertake to serve wherever required at Admiralty Headquarters and outports in the United Kingdom, and at Royal Dockyards at Home and Abroad. The Head of the R.C.N.C. is the Principal Technical Adviser to the Board of Admiralty.

The starting pay of a Probationer at age 18 will be £535. A deduction of £75 is made when living in at the R.N. Engineering College, Manadon, or at the R.N. College, Greenwich. The successful Probationer can expect appointment as Assistant Constructor at age 23 or 24, with a starting salary in London of not less than £905 and £935, respectively. Promotion to Constructor normally takes place at about age 30, with a salary which may be expected to be not less than £1435, rising in nine years to not less than £2050. Promotion to higher ranks is by selection.

Full particulars may be obtained from the Secretary of the Admiralty, C.E. Branch II, Empire Hotel, Bath, to whom final application must be submitted by 16th June, 1958. E6608

CIVIL SERVICE COMMISSION

MINISTRY OF TRANSPORT AND CIVIL AVIATION

INSPECTOR OF ACCIDENTS (CIVIL AVIATION)

Pensionable post in London for man at least 30 on 1st April, 1958. Qualifications: Airline Transport or Senior Commercial Pilot's licence and considerable flying, including at least 1000 hours as pilot in command. Knowledge of aeronautical engineering necessary, normally to standard required for aircraft engineer's licence; lower if specialised knowledge of navigation offered. Salary £1350–£1605. Promotion prospects.—Write, Civil Service Commission, 30, Old Burlington Street, London, W.1, for application form, quoting S4841/58. Closing date 4th July, 1958. E7136

NATIONAL COAL BOARD N.W. DIVISION

NO. 1 (MANCHESTER) AREA

CHIEF WORKSHOPS PLANNER

CHIEF WORKSHOPS PLANNER, Central Workshops. Salary range: £900–£1400 per annum.

A broad engineering experience is essential. Candidates must be used to jobbing production and have ability in organising and controlling staff. Knowledge of modern planning and production control techniques in large works will be an advantage.

Applications, stating age, qualifications, experience, present post and salary, to the Area Staff Manager, No. 1 (Manchester) Area, Walkden, Nr. Manchester, within 10 days. E7183

NORTHERN GAS BOARD (TYNESIDE DIVISION)

REDHEUGH WORKS

MECHANICAL AND ELECTRICAL ENGINEERING ASSISTANT

Applications are invited for the above appointmen at a salary within Grade A.P.T. 10 (£860–£960 per annum) of the National Salary Scales for Gas Staffs.

The person appointed is, under the overall control of the Works Manager, to take complete control of maintenance of all mechanical and electrical equipment at these works, which can produce up to 24 million cu. ft. of town's gas per day and, in addition, is required to purify 18 million cu. ft. a day of coke-oven gas.

Applicants should hold a recognised qualification in Mechanical Engineering and experience of planned preventive maintenance schemes would be an advantage.

The successful candidate will be required to pass a medical examination and join the Board's pension scheme.

Applications, stating age, qualifications and experience, together with the names of two referees, should be submitted to the undersigned not later than 30th May, 1958.

W. SUTCLIFFE,
Divisional General Manager.

30, Grainger Street,
Newcastle upon Tyne, 1,
8th May, 1958. E7167

DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES, AUSTRALIA

CIVIL ENGINEERS

Applications are invited from graduates (or undergraduates in their final year) in Civil Engineering of a recognised British or Irish University for appointment to the staff of the Department of Main Roads, New South Wales, the State Road Authority for construction of roads and bridges.

On appointment, applicants may be engaged at the Department's Head Office, Sydney, on the design of reinforced concrete and steel bridges, or on main road construction and maintenance either in the Metropolitan Area or the country.

Commencing salary according to qualifications and experience will be within the range £A1134 to £A1340 per annum, with annual progression, subject to technical competence to £A1866 per annum. Appointees will be eligible to contribute to the State Superannuation Fund after six months.

Appointee's full fare from England to Australia will be met by the Department, subject to a three years' service guarantee bond being completed. Appointment will be subject to passing a medical examination and preference will be given to applicants not more than 30 years of age.

Applications should be made on forms obtainable from the Agent General for New South Wales, 56, Strand, London, W.C.2. E7170

EAST ANGLIAN REGIONAL HOSPITAL BOARD

REGIONAL ENGINEER'S DEPARTMENT

APPOINTMENTS

SENIOR ASSISTANT ENGINEER.—Candidates should be Corporate Members of Institution of Mechanical Engineers, or have been professionally graded in National Health Service at January, 1953. Must be capable of designing, drafting specifications and working drawings, and supervision of contracts for mechanical engineering services within hospitals, comprising heating, ventilating, hot and cold water services, steam boiler plant, laundries, kitchens, &c. Experience in surveying and reporting upon existing installations desirable. Control and supervision of junior staff. Salary £1010–£1195.

ASSISTANT ENGINEERS (MECHANICAL).—Candidates should be A.M.I.H.V.E. or Graduate Members of the I.H.V.E., or possess exempting qualifications. Experience in design and installation of heating, ventilating, steam boiler plant and services, &c., as applicable to hospitals desirable, but not essential. Salary £700–£1015—additional increments within scale based on experience and age may be granted.

Applications, stating age, qualifications, experience and details of present position (salary, &c.), with names of two referees, to Secretary of Board, 117, Chesterton Road, Cambridge, by 31st May, 1958. E7135

PUBLIC APPOINTMENTS

WEST KENT MAIN SEWERAGE BOARD

APPOINTMENTS

Applications are invited for appointment as :

(a) ASSISTANT RESIDENT ENGINEER, for a period of two years at £900 p.a. Large extensions are under construction at the Board's works at Dartford. The position affords an opportunity to candidates who require practical experience before professional interview to complete qualification as A.M.I.C.E.

(b) JUNIOR ENGINEERING ASSISTANT, at £585, rising to £755 p.a. (A.P.T. I, plus London allowance). Local government superannuation. Applicants must have experience of general engineering drawing-office practice.

Applications, stating post applied for, with full personal details, particulars of education, training and experience, and the names and addresses of two referees, must reach me within ten days after publication of this advertisement.

A. J. W. JEFFERY,
Secretary of the Board.

20, Blyth Road,
Bromley, Kent. E7138

SOUTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD

ENGINEERING ASSISTANT

Applications are invited for the appointment on the permanent staff of the Regional Engineer's Department of an ENGINEERING ASSISTANT. The Department is at present at Kingston-on-Thames, but is moving in the near future to Paddington.

Applicants should have a sound knowledge of modern hospital equipment and be capable draughtsmen. The commencing salary will be within the scale (i) £525 (at age 21 or over) by £20 (4) by £25 (5) to £730 for candidates possessing the Ordinary National Certificate or an examination of equivalent standard, or (ii) £655 (at age 23 or over) by £25 (4) by £30 (1) by £35 (4) by £40 (1) to £965, for candidates possessing the Higher National Diploma in Mechanical Engineering or a qualification of equal or higher standard. London weighting of £20 to £40 p.a. payable in addition.

Application forms are obtainable from the undersigned at 11a, Portland Place, W.1, to whom they should be returned by 26th May, 1958.

E7160 E. G. BRAITHWAITE, Secretary.

FIFE COUNTY COUNCIL

ENGINEERING ASSISTANT

ENGINEERING ASSISTANT required for County Engineer's Department. Salary Grade A and P 6, 7, 8 (£865 to £1055) per annum, or Grade £966 to £1207, depending on age and experience. Applicants must be qualified civil engineers and should have had some years' experience in the design and construction of works of water supply. House may be available.

Further particulars and forms of application obtainable from the County Engineer, Belfield, Cupar, Fife. Applications by 26th May to the County Clerk, Cupar, Fife. E7139

ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL,

require

X-RAY TECHNICIAN

to be responsible to a Senior Officer for the operation of a Non-Destructive Test Section.

Recognised apprenticeship or equivalent training essenital ; O.N.C. desirable.

Salary range £700–£875.

Send post card for application form to Group Recruitment Officer (1014/25), A.E.R.E., Harwell, Didcot, Berks. E7161

TENDERS

INDIA STORE DEPARTMENT

WELDABLE SEAMLESS TUBES

The Director General of India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites TENDERS for the SUPPLY of:

	Quantity, feet
WELDABLE SEAMLESS TUBES :	
(a) 1¼in. O.D. × 1⅛in. I.D., to St. 45.29...	7,500
(b) 5/16in. O.D. × 4/16in. I.D., to St. 35.29...	950
(c) 1¼in. sq. × 5/16in. wall thickness, to St. 35.29	46,500

Forms of Tender may be obtained from the above address on or after 16th May, 1958, at a fee of 10s., which is not returnable. If payment is made by cheque, it should please be made payable to "High Commissioner for India." Tenders are to be delivered by 2 p.m. on Thursday, 3rd July, 1958.

Please quote reference No. 4/58.DB/RLY.2. E7130

INDIA STORE DEPARTMENT

LATHES

The Director General, India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites TENDERS for the SUPPLY of:

18 Nos. LATHES for machining shells approximately 3in. to 4in. dia. up to 18in. long, similar to Canadian Hepburn Models 2P, 5P, 28P, 6P, 10P, 8P and 11P, size A. Dimensional drawings of shells showing machining to be done are available.

Tender schedules and specifications may be obtained from the above address at a fee of ten shillings, which is not refundable. Cheques should be made payable to High Commission of India. The applications for Tender forms should state reference 2085/57/EN.3.

Tenders, complete with specifications, to be submitted by Monday, the 14th July, 1958. E7141

TENDERS

CITY AND COUNTY OF KINGSTON UPON HULL

CITY ENGINEER'S DEPARTMENT

PROPOSED NEW DRYPOOL BRIDGE—MECHANICAL AND ELECTRICAL CONTRACT

The Property and Bridges Committee of the Corporation proposes to proceed, at an early date, with the construction of a rolling lift type, overhead kentledge, single leaf lifting bridge over the River Hull. The moving span of the bridge will weigh approximately 1800 tons, the overall span will approximate to 105ft. and the carriageway width will be of the order of 45ft.

The Committee is, therefore, prepared to receive applications from Mechanical and Electrical Contractors with considerable experience in this specialised work for permission to tender for the provision and the erection of the necessary bridge elevating mechanism comprising extra heavy racks, heavy gear type winding frames, motive power units, road traffic gates, traffic signals, obstruction lighting and auxiliary services, the whole to constitute a comprehensive main Mechanical and Electrical Contract having a value of the order of £100,000.

Initial applications from suitably qualified firms shall be forwarded direct to the City Engineer so as to arrive not later than Monday, 2nd June, 1958. On receipt of these applications a selection will be made and tender documents will be issued to the selected applicants about the middle of June. Full details of the method of tendering will be communicated to the successful applicants with the tender documents and it is anticipated that about ten weeks will be allowed for the preparation of tenders.

The foregoing announcement applies only to the Mechanical and Electrical contract. A further announcement will be published in respect of the Main Structural contract at a later date.

WM. MORRIS, O.B.E.,
City Engineer.

Guildhall.
Kingston upon Hull. E7171

SURREY COUNTY COUNCIL

HIGHWAYS AND BRIDGES DEPARTMENT

CONSTRUCTION OF FLY-UNDER AT JUNCTION OF KINGSTON BY-PASS (A.3) AND HOOK ROAD (A.243)

TENDERS are invited for the CONSTRUCTION of the above FLY-UNDER. The works include the construction of earthworks, drainage, retaining walls, roadworks, two prestressed concrete bridges ; the erection only of a steel footbridge, and other ancillary works. The contractor must have carried out successfully road and bridge construction works of a similar size and nature, and must satisfy the Council that he has done so. He must further satisfy the Council that he has the necessary equipment and skilled personnel to complete the whole of the works satisfactorily under the conditions obtaining and within the contract time.

Copies of the Tender documents can be obtained from the County Engineer, County Hall, Kingston-upon-Thames, and returnable by 12th July, 1958.

The Council do not bind themselves to accept the lowest or any Tender. E7182

INDIA STORE DEPARTMENT

PRESSES

The Director General, India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites TENDERS for the SUPPLY of:

(i) One 75-ton CRANK PRESS (reference 2334/57/ENG.3).

(ii) One 500 tons CRANK PRESS, double sided double or treble geared (reference 2337/57/ENG.3).

(iii) One 200 tons CRANK PRESS, double geared (reference 2338/57/ENG.3).

(iv) One 200 tons variable-speed, single-rack DRAW PRESS, for drawing 70/30 brass heavy-calibre cartridge cases, involving both diametral and thickness reduction (reference 2331/57/ENG.3).

Tender schedules and specifications may be obtained from the above address at a fee of ten shillings, which is not refundable. Cheques should be made payable to High Commission of India. The applications for Tender forms should state reference(s) against which Tender schedules are required.

Tenders, complete with specifications, to be submitted by Monday, the 7th July, 1958. E7142

SOUTHPORT AND DISTRICT WATER BOARD

SCARISBRICK WATERWORKS —CONTRACT NO. 18

OIL FUEL STORAGE TANKS

Tenders are invited for supplying and installing steel fuel tanks at Mill Brow Pumping Station, Scarisbrick, near Southport.

Conditions of contract, specification, tender form and drawing may be obtained from the Engineer and Manager, 14, Portland Street, Southport, on payment of two guineas which deposit will be refunded upon receipt of a bona-fide tender and/or return of the documents.

Sealed tenders enclosed in a plain envelope endorsed "Tender for Oil Tanks—Contract No. 18" must be delivered to the undersigned at the Town Hall, Southport, before 10 a.m. on Tuesday, 27th May, 1958.

R. EDGAR PERRINS,
E7173 Clerk to the Board

EDUCATIONAL

UNIVERSITY OF EDINBURGH

POST-GRADUATE SCHOOL OF APPLIED DYNAMICS

A Post-graduate Course, leading to the Diploma in Applied Dynamics, will be given in the Department of Engineering from October, 1958 until June, 1959. The Course will provide specialised training for graduates who are working, or who intend to work, on dynamical problems. Applicants should hold an Honours degree in Engineering, Mathematics or Physics.

The main Lecture courses will be in dynamics of solids, analytical methods, mechanical vibration, gyrodynamics, and theory of control systems. Laboratory work in the field of applied dynamics will also be undertaken.

A limited number of grants may be awarded to suitable candidates.

Further particulars and forms of application may be obtained from the Faculty of Science Office, Chemistry Department, University of Edinburgh, West Mains Road, Edinburgh, 9.

CHARLES H. STEWART,
Secretary to the University.

May, 1958

E7172 E

TECHNICAL HOME STUDY COURSES

For A.M.I.Mech.E.,
A.M.I.Chem.E., A.M.I.M.I.,
A.F.R.Ae.S., C. & G., &c.

OVER 50 FIRST PLACES and more than 2000 Passes have been secured by T.I.G.B. Students at Professional Engineering Examinations. We have a wide range of exclusive Home Study Courses in all branches of Engineering—Mechanical, Electrical, Aeronautical, Automobile, Chemical, Gas, Radio, and Television, Draughtsmanship, &c. Textbooks, blueprints, &c., are provided and, if desired, fees may be paid by moderate instalments.—Write (stating subject of interest) for copy of 110-page Prospectus FREE and without obligation.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN

(Dept. 76),
29, WRIGHT'S LANE, LONDON, W.8.
E102 E

A.M.I.MECH.E., B.Sc., City and Guilds, &c. Guarantee Postal Courses for all Exams., and Technical Divisions from Elementary to Degree standard. Approximately 95 per cent. successes. 144-page prospectus free on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E721 E

FREE ! Brochure giving details of Courses in Mechanical and Production Engineering, Draughtsmanship, &c., for the A.M.I.Mech.E., A.M.I.P.E., City and Guilds and other professional examinations. —E.M.I. Institutes, Dept. E.30, London, W.4. (Associated with H.M.V.) E972 E

U.K.A.E.A.

Harwell Reactor School Control and Instrumentation of Reactors Course

A course on "The Control and Instrumentation of Reactors" is to be held at the Harwell Reactor School from 6th to 11th October, 1958, inclusive.

The fee for the course will be 25 guineas exclusive of accommodation.

Application forms and further details can be had from

The Principal,
Reactor School,
Atomic Energy Research Establishment,
Harwell,
Berkshire. E7144 E

SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES, NOT ORIGINALS, OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED

A MECHANICAL ENGINEER required by a leading company of Aluminium Manufacturers for an interesting post in their Sales Engineering Department in London. The successful applicant will be about 30 years of age, and an Associate Member of The Institution of Mechanical Engineers, with experience in the field of domestic and similar appliances. A knowledge of aluminium and its applications is desirable but not essential.—Full details of qualifications and experience should be sent to BOX No. E1880, "The Engineer." A

A POSITION AVAILABLE with prominent British company for young, qualified MECHANICAL ENGINEER, for heavy chemical plant development. A sound technical background essential, with some factory experience—preferably with chemical plant layout and design—with particular reference to mechanical handling. The appointment would be based on London. Good pension scheme and other amenities. Please reply, giving details of age, qualifications and experience.—BOX No. E7146, "The Engineer." A

SITUATIONS VACANT

A MACHINE TOOL MANUFACTURING FIRM IN BIRMINGHAM

has a vacancy for a

WORKS SUPERINTENDENT

Age 35 to 50 years, fully experienced in machining or toolroom work.

Four-figure salary.

For further information contact :

Technical Advisory Service,
Birmingham Productivity Association,
95, New Street, Birmingham, 2, MID 0912,
quoting reference 208/PM.

E7180 A

A PROGRESSIVE ENGINEERING COMPANY in the Victoria area of London requires a DRAUGHTSMAN for a responsible post in small drawing-office. This post offers good prospects and an attractive salary to a man with general engineering experience. Five-day week and pension scheme in operation.—Please send details of experience to the Chief Draughtsman—THE WELLMAN BIBBY CO., LTD., ARTILLERY HOUSE, ARTILLERY ROW, LONDON, S.W.1. E7150 A

Applications are invited from :

(a) ELECTRICAL ENGINEER DRAUGHTSMEN
for complete electrical installation and design work, including motor application.

(b) DESIGNER & DETAIL DRAUGHTSMEN
for general mechanical engineering, preferably experienced in machine shop practice. Knowledge of platework, pressure vessels and heat exchangers would be advantageous.

(c) SENIOR REINFORCED CONCRETE DESIGNER DRAUGHTSMEN
experienced in the design of foundations and structures.

Top salaries. Newly-built semi-detached houses will be available shortly for successful candidates. Allowances made until removal effected. Grant towards removal expenses. Pension and Life Assurance Schemes.—Apply, The Power-Gas Corpn. Ltd. (Inc. Ashmore, Benson Pease & Co.), Stockton-on-Tees. E7100 A

ARE YOU A DRAUGHTSMAN WHO THINKS OF HIS FUTURE !

If so, you may be the right man to fill a vacancy that offers interesting work and excellent prospects.

We require a general engineering draughtsman, age 25–30, of at least Ordinary National Certicate standard, preferably with some experience of Hydraulics, Mould Design and Steam Raising Equipment.

We are an old-established family concern whose staff work a five-day week in pleasant conditions, have a good canteen and a non-contributory pension scheme.

If you are interested, please apply by letter to :

THE PERSONNEL MANAGER,
TUFNOL, LTD.,
PERRY BARR,
BIRMINGHAM, 22B

E1865 A

ASSISTANT CHIEF ENGINEER required for large Confectionery Manufacturers in N.E. London. Qualification Hons. degree or equivalent in Mechanical Engineering combined with sound practical experience in the installation and maintenance of plant and general factory services including preferably air conditioning, steam utilisation and building construction. Preference will be given to candidates with recent drawing office connection and with ability to develop special process plant and layouts in this trade. The post is responsible and an appropriate salary will be paid.—Details of age, experience, &c., to BOX No. LUK, Dept. "D," c/o Dixons, 1/9, Hills Place, Oxford Street, W.1. E7166 A

ASSISTANT CIVIL/STRUCTURAL ENGINEERS required by Consultants for design, &c., of important R.C. and steel structures ; also maritime works. Experience suitable for professional qualifications. New offices ; 5-day week ; holidays honoured ; salaries by agreement.—Wilton and Bell, Roman House, Cripplegate Buildings, London Wall, E.C.2 (MONarch 6341). E1848 A

CHATWOOD-MILNER, LTD., Shrewsbury, require a SENIOR ESTIMATOR with wide experience of general engineering. Pension scheme operating.—Apply, with full details of experience and salary required, to the Chief Accountant. E7127A

CHIEF DRAUGHTSMAN required for Drawing Office of Structural Department in Stoke-on-Trent. Good salary, pension scheme.—Apply in writing in first instance to General Manager, Shelton Iron and Steel, Ltd., Stoke-on-Trent. E1846 A

CHIEF DRAUGHTSMAN required for West of England progressive company. Steel pipework, design, fabrication and erection. Pension scheme.—BOX No. E7131, "The Engineer." A

CIVIL ENGINEERING CONTRACTORS require PLANT ENGINEER to supervise erection, maintenance and repair of plant on major construction contract in England. Minimum requirements are Ordinary National Certificate in Mechanical Engineering and some experience of heavy public works plant. Excellent opportunity. Write, with full details of age, training and experience, quoting Ref. NOP.2.—BOX No. E7149, "The Engineer." A

Classified Advts. continued on page 132

SITUATIONS VACANT

CONSULTING ENGINEERS engaged on varied r.c. and steel structural works, general civil engineering work and foundation problems, require capable assistants both for design and for detailing. Five-day week. Luncheon Vouchers.—Apply Maurice Nachshen and Partners, 58, Victoria Street, London, S.W.1. E1878 A

COURTAULDS, LIMITED,
have a vacancy for a
POWER STATION SUPERINTENDENT
at their
MAIN WORKS, COVENTRY

An experienced engineer is required to be responsible to the Works Engineer for the safe and efficient operation and maintenance of an industrial power plant comprising five medium-pressure, stoker-fired, water-tube boilers, three pass-out condensing turbines, together with auxiliary equipment.

The candidate must be suitably qualified, have held positions of responsibility and be thoroughly conversant with the problems of steam and power generation in industrial plants of similar type to that outlined above.

Candidates should write for a detailed form of application to the Director of Personnel, Courtaulds, Limited, 16, St. Martins-le-Grand, London, E.C.1, quoting reference number B.46. E7070 A

DESIGNER DRAUGHTSMAN with H.N.C. or O.N.C. in Mechanical Engineering, required for Development Department of company in West Midlands. The post is permanent and pensionable; interesting work in a small team engaged in the development of special purpose machinery. Salary according to age and experience but not below A.E.S.D. rates. Apply, giving full particulars of age, experience and qualifications.—BOX No. E1871, "The Engineer." A

DESIGNING ENGINEER—experience in mobile cranes essential. Knowledge of hydraulics advantageous. To take control of drawing-office, Glasgow. Good prospects for conscientious, ambitious man.—BOX No. E7148, "The Engineer." A

DESIGNER REQUIRED for modern Rolling Mills and auxiliary equipment.

This post offers every opportunity to the right type of man.

Reply fully, in strictest confidence.—BOX No. E6988, "The Engineer." A

DETAIL DRAUGHTSMAN required, having experience in Industrial Furnaces, Gas Plant or similar work. Write, giving full particulars and salary required, to Chief Draughtsman, Furnace Department, The Wellman Smith Owen Engineering Corporation, Ltd., Parnell House, Wilton Road, London, S.W.1. E7184 A

DEVELOPMENT ENGINEER required for mass production precision engineering works in North Midlands. The methods and processes are of a varied nature covering in the main, machining, grinding, assembly and inspection and the appointment is with a view to introducing new and improved methods on a high precision quality product. Applicants, who should be about 35 years of age, must have had good technical and practical experience, possess initiative, discernment and have a flair for experimental work and investigation, will be given guidance and every assistance. Some knowledge of electricity desirable. The position is permanent for a suitable applicant who should derive considerable satisfaction and interest from the work. Housing assistance given. The Company is old established and operates a pension scheme. Reply in confidence giving full particulars of experience, qualifications, salary required and age. No original testimonials please.—BOX No. E7077, "The Engineer." A

DEVELOPMENT ENGINEERS

Due to our expansion programme covering our Hatfield site, we need the following additional staff:

A SENIOR DEVELOPMENT ENGINEER. To lead a section responsible for electronics and instrumentation for Development Test Facility. The successful applicant will need to have graduated in Electrical Engineering, and have a wide experience in this field. This is a monthly staff appointment.

DEVELOPMENT ENGINEERS with a knowledge of, and experience in any of the following:

1. Combustion Equipment and Heat Exchangers.
2. Fuel Systems and Components.
3. Mechanical Equipment.
4. Pneumatic and Hydraulic Equipment.

Minimum qualifications include H.N.C. (Mechanical, Civil or Structural) and the salary range is between £13–£17 per week.

Please write to the Personnel Manager (Ref. CTT.17),
DE HAVILLAND PROPELLERS LIMITED,
Conquest House, 37/39, John Street, Theobalds Road, London, W.C.1. E7176 A

DEVELOPMENT ENGINEER

required by progressive medium-sized engineering organisation in pleasant town in Midlands to work on the design and introduction of machines, plant and handling equipment for the manufacture of a specialised engineering product.

Qualifications required—H.N.C. or equivalent. Age limit 45.

Salary range £950 to £1250 p.a., depending on qualifications and experience. Good pension. Assistance with removal expenses.—Please write, in confidence, to BOX No. E1876, "The Engineer." A

DRAUGHTSMAN wanted for permanent position for Centrifugal Pump and Plant Layout work. Skilled drawing experience essential. Pump experience some advantage. Minimum standard H.N.C. Pension scheme operating.—Apply, Secretary, LEE, HOWL & CO., Limited, TIPTON, Staffs. E7153 A

DRAUGHTSMAN (MECHANICAL) Intermediate—wanted for Design and Planning Section of progressive organisation. Excellent prospects. Pension scheme.—Write, Chief Draughtsman, Matisa Equipment, Limited, Hanworth Lane, Chertsey, Surrey. E1858 A

DRAUGHTSMEN.—The National Smelting Co. Ltd., Avonmouth, offers good opportunities to experienced MECHANICAL DRAUGHTSMEN for design and detail work in connection with metallurgical and chemical plant and equipment. A wide variety of work is offered and good promotion prospects exist for young men holding or prepared to obtain H.N.C. or equivalent. All appointments are permanent and pensionable with excellent working conditions and amenities.—Write to Personnel Manager for application form, quoting ref. DN7/TE. E7126 A

ENGINEER required with automobile suspension experience. Duties will include design, development and contact with customers.—Apply, in writing, stating age, training, experience and salary range, to Andre Rubber Co., Ltd., Kingston By-Pass, Surbiton, Surrey. E7128 A

ENGINEER required by small and progressive light engineering firm in Cambridge, for interesting development work and promotion. Applicants should have an engineering degree. Experience in high vacuum some advantage.—Apply in writing giving full details to General Manager, Vacuum Research (Cambridge), Ltd., Quayside, Bridge Street, Cambridge. E1875 A

ENGINEERING CLERK OF WORKS required for site supervision of extensive Engineering and Electrical reservicing installation in existing Hospital in Bristol. Duration of contract approximately 2½ years commencing August, 1958. Salary £750 per annum for man with at least 10 years' supervisory experience of this class of work.—Write, stating age and experience to: Messrs. Hoare, Lea and Partners, Consulting Engineers, 21, Oakfield Road, Clifton, Bristol, 8, marking envelope "Clerk of Works." E1877 A

FOREMAN of outstanding ability required for expanding Sheet Metal Shop with long-term contracts and development projects for many industries.

Practical experience of following essential:—

Large and small stainless steel fabrications, including heavy gauges and general sheet metal work—Argon-Arc and metallic arc welding—development and setting-out—polishing—shop planning and rate fixing.

Strong and responsible disciplianarian.

Prospects and salary will be commensurate with responsibility demanded for this senior staff appointment.

Only those with proven ability in similar position can be considered.

Apply, with full details of apprenticeship and experience, to Managing Director, Geo. Adlam & Sons, Ltd., Parnall Road, Fishponds, Bristol. E1861 A

FOREMAN FOR GEAR CUTTING SHOP
required by
W. H. ALLEN SONS & CO., LTD.,
ATLAS WORKS, PERSHORE, WORCS.

manufacturers of light and medium-sized precision gearboxes. Applicants should have a sound practical background of hobbing, shaping, gear grinding and shaving, together with the necessary qualifications and ability to carry out the calculations connected with these operations. Knowledge of gear checking on involute and helix testers to close tolerances is essential. Good superannuation scheme and conditions. Successful applicant would be assisted in the removal of household effects to district concerned, in which housing accommodation will be available. Apply (in confidence), stating experience, positions held and salary range, to the PERSONNEL MANAGER at the above address.

E7187 A

HEATING ENGINEERS. A Midland Company require a SENIOR DESIGN ENGINEER as Assistant to the Chief Designer. Applicants should have extensive experience in design of industrial installations and be capable of dealing with projects through all stages of negotiation.—Apply, with full details, to Sales Director, BOX No. E7093, "The Engineer." A

JOHN LAING AND SON, LIMITED,
invite applications from
ASSISTANT SITE ENGINEERS, with experience of setting out and general site engineering duties on a variety of important contracts in the British Isles. A Civil Engineering Degree or the equivalent is desirable, but not essential.

Those interested should write to:
PERSONNEL MANAGER (Ref. A.S.E.1),
JOHN LAING AND SON, LIMITED,
LONDON, N.W.7. E7133 A

JUNIOR DRAUGHTSMAN required. Experience in mechanical handling plant an advantage. Good prospects. British Industrial Sand, Ltd., High Street, Godstone, Surrey. E1852 A

MACHINE SHOP attached to Electric Lamp factory requires MANAGER. Must be capable of initiating and supervising the building of high-speed machinery.—Applicants should state previous experience and salary required.—BOX No. E1874, "The Engineer." A

REQUIRED.—To take charge of Inspection Department, in London District, technically qualified MECHANICAL ENGINEER with experience of welding pressure vessel, and sheet metal work. Experience of refrigeration an asset but not essential. State age, experience and salary required in confidence.—BOX No. E7109, "The Engineer." A

METALLURGIST

Non-Ferrous Metals Department of large engineering establishment on North East Coast has immediate vacancy for an experienced WORKS METALLURGIST.

The Department which comprises Brass Foundry, Electric Melting Shop, Rolling Mills and Extrusion Presses, handles principally Copper and Copper Alloys, and the successful applicant will be required to deal with production, control and development problems, and to work in collaboration with the central chemical and metallurgical laboratories.

The post carries an attractive salary, and a superannuation scheme is in operation.

Candidates, who should possess a University Degree, are invited to write, giving in confidence, age and full details of practical and educational qualifications, to BOX No. E7190, "The Engineer." A

PRESTFIBRE, LTD.,
SPENCERS WOOD, READING

Expanding sales of new process for wood-fibre mouldings for industry (incl. Motor and T.V.) necessitates:

A MECHANICAL DRAUGHTSMAN
for toolmaking design and master drawings. Excellent prospects for first-rate man with experience. Salary to suit.—Apply to Works Director giving full history. E7092 A

PROJECTS AND CO-ORDINATING ENGINEER
CHEMSTRAND LIMITED

have an immediate vacancy in their works at Coleraine, Northern Ireland, for a fully qualified chemical or mechanical engineer in the 28–32 age group preferably with experience in the chemical or petroleum industry.

Responsibilities will include special studies and long range planning, drawing office services and engineering co-ordination between departments.

Starting salary £1,000 per annum upwards according to age and experience. Pension scheme. Career prospects. Housing available locally.

Please apply in confidence with brief personal and career details and current salary to Staff Personnel Manager, Chemstrand Limited, 8, Waterloo Place, London, S.W.1, quoting Ref. PCE. E7163 A

REQUIRED for the Southern Railway of Peru, Limited, CARRIAGE AND WAGON SUPERINTENDENT. Must have served a general Engineering Apprenticeship, preferably in a Railway Workshop and have attained at least the Ordinary National Standard of Technical Education in Mechanical Engineering. Should also have no less than five years' experience in a supervisory capacity directing and handling men. Age 28–35. Ability to speak Spanish would be a great advantage. Salary £1350 per annum.—Apply in writing to Peruvian Transport Purchasing Co., Ltd., Rex House, 38, King William Street, London, E.C.4. E7189 A

SALES ENGINEERS required for medium-sized precision engineering establishment in the Reading area. Only keen energetic Electro-Mechanical Engineers who possess the following qualifications need apply: Previous sales experience; Initiative to sell engineering facilities on a sub-contract basis; and the Company's products direct to the Aircraft and Automotive Industries. Write, in first instance, in strictest confidence, giving full details of experience and salary required.—BOX No. E7143, "The Engineer." A

SENIOR ASSISTANT required in London by Professional firm to assist in planning and design of sewerage and drainage schemes including sewage purification works. Duties may include short trips abroad. Post is not temporary and carries pension assurance. Age range 30 upwards with professional qualifications preferred.—Apply, BOX No. E7186, "The Engineer." A

SENIOR DESIGN AND RESEARCH APPOINTMENTS

Applications are invited from University Graduates, preferably with Honours degrees and current experience either in the engineering and technical design of large gas cooled reactors or in research and development associated with reactor components. Apply in writing to:
The Secretary (Ref. 3/MG),
Atomic Power Constructions, Ltd.,
28, Theobalds Road,
London, W.C.1. E7165 A

SENIOR MECHANICAL ENGINEER

A vacancy exists for a senior Mechanical Engineer with experience in the inspection and testing of plant and materials particularly turbo-alternators, pumps and blowers required for nuclear power stations. Duties involve liaison with design departments, general supervision of contracts and visits to works of sub-contractors as required. Candidates should be over thirty years of age and Corporate Members of the Institution of Mechanical Engineers or equivalent.

Applications giving full details should be addressed to:
The Secretary (Ref. 4/SO),
Atomic Power Constructions, Ltd.,
28, Theobalds Road,
London, W.C.1. E7164 A

SENIOR DRAUGHTSMAN, over 35, required by Midland firm to handle all Mechanical and Electrical Details of Contracts for Pumps, Pipework, Control Gear, &c. Some supervision experience necessary. Superannuation scheme available. Minimum starting salary £900.—BOX No. E7154, "The Engineer." A

SENIOR DESIGNER DRAUGHTSMAN with flair for design work, required by small/medium-size engineering firm in South West London, building paper making machinery. Previous experience in this field is not essential but applicants should have qualifications at least equal to Higher National Certificate standard. The work is interesting with opportunities for studying equipment in the field. The prospects are good. Pension scheme. Reply.—BOX No. E7042, "The Engineer." A

SENIOR SALES ENGINEER

Well-constituted engineering company, involved mainly in the chemical and petroleum industry, wishes to fill a vacancy for a Senior Sales Engineer.

The successful applicant would be required to take over and develop an existing area in the Northern half of England.

Applicants should be 30–40 years, with good qualifications and preferably some knowledge of mechanical or chemical engineering.

This is a technical appointment which offers good possibilities for the right man, and only those with the necessary qualifications and the personality to make the most of them should apply.

Previous representative experience would be an asset, but is not essential providing the applicant has drive and personality.

Remuneration by salary and expenses, with company motor-car provided. Attractive pension and Life Group Assurance schemes in operation, and housing assistance given if necessary.

Please write in confidence, giving age, full details of experience and salary required.—BOX No. E7120, "The Engineer." A

STAINLESS STEEL DYEING MACHINERY DESIGNER required by expanding company, to initiate new designs for pressure and textile dyeing machinery and finishing plant; must be experienced in this class of work and have the necessary theoretical and practical background; every assistance will be given to the successful applicant to settle down in this area; full canteen facilities are available. The position will attract a four-figure salary, dependent upon experience and ability.—Write in first instance, giving details of age, experience and qualifications, to the Managing Director, Freeman, Taylor Machines, Ltd., Necton Street Works, Syston, Nr. Leicester. E1866 A

TECHNICAL SALES SERVICE MANAGER

required immediately by an expanding company in the Steel Equipment Industry. Applicants should have had experience in the sheet metal industry, be capable of controlling staff and have a thorough knowledge of Estimating. Experience of costing procedures and process planning an advantage. The appointment carries a four-figure salary and a pension scheme is in force. Only those giving full details of experience, age, salaries earned, &c., will be considered. Write to Sales Director.—BOX No. E1857, "The Engineer." A

TURNER BROTHERS ASBESTOS CO. LTD.,
ROCHDALE, LANCASHIRE
require an ENGINEER for the position of
EXPORT TECHNICAL
REPRESENTATIVE

Applicants should be under 40 years of age, possess Associateship of the Institution of Mechanical Engineers, or its equivalent, and be thoroughly conversant with all engineering components involving the use of asbestos and plastics. The successful candidate will be based at the Company's Rochdale Factory in the role of consultant, but will be called upon for occasional duties abroad. The post calls for a wide knowledge of engineering, due to the many and diverse uses of the Company's products in this field, but a reasonable period of training will be given before duties are commenced.

Applications, giving full particulars and details of salary required, should be addressed to the Personnel Manager, and envelope should be endorsed "Export Sales Representative." E7155 A

WANTED, IN WESTMINSTER, a man accustomed to compiling, laying out, and progressing engineering catalogues from copy and subject matter provided, and checking the proofs. Design and drawing ability not essential, but must be good, neat typographer and used to advertisement mark-ups. No smoking in the office; 5-day week.—BOX No. E7129, "The Engineer." A

WORKS MANAGER, aged 35-40, for sheet metal works 15 miles South of London employing 100. Knowledge modern methods of production and control essential. Write stating age, salary required, previous experience.—BOX No. E7134, "The Engineer." A

WORK STUDY ENGINEER

required to assist in development of Work Study in all its aspects, with emphasis on Method Study. Excellent opportunity for trained man age 25–35 with sound engineering qualifications and background and with practical experience of method study in an engineering establishment.

Please write giving age, salary required and full details of qualifications and experience, in confidence to:
Personnel Manager, Universal Grinding Wheel Co., Ltd., Stafford. E7179 A

YOUNG MEN, aged up to 28 years, required for training as ROLLING MILL SHIFT MANAGERS in large Midlands steelworks. This is a job offering excellent prospects to those selected and a good starting salary will be paid. Staff position, pension and free life assurance schemes in operation. Full details of age, experience and qualifications.—BOX No. E7121, "The Engineer." A

SITUATIONS VACANT

OIL ENGINE DRAUGHTSMEN

ENGLISH ELECTRIC COMPANY, RUGBY,

require Detail Draughtsmen for their Oil Engine Drawing-Office. Applications would be welcome from men with experience of heavy oil engines and preferably with O.N.C.—Write, giving full particulars, to Dept. C.P.S., 336/7, Strand, W.C.2, quoting ref. E1199K.

E7147 A

SITUATIONS VACANT

DEVELOPMENT ENGINEERS

are required by Girling, Limited, to deal with the increasing programme of development of new and established products.

DEVELOPMENT ENGINEERS — with degree or H.N.C., to take responsibility for the development of a range of products.

ASSISTANT DEVELOPMENT ENGINEERS—with H.N.C. and some development experience.

TECHNICAL ASSISTANTS (age 21-28 years) with O.N.C. and an interest in development work.

Salaries will be determined by qualifications and experience and will range from £800 p.a. for Assistant Development Engineers and from £950 p.a. for Development Engineers.

Apply in writing giving all relevant details of qualifications and background to the Personnel Manager, Girling, Limited, Kings Road, Tyseley, Birmingham, 11.

E7073 A

The world's leading inventors and manufacturers of special purpose precision machinery for the Tobacco Industry have openings in their London Drawing Offices for :

MECHANICAL DESIGNER ELECTRICAL DESIGNER

In each instance applicant should be Qualified Engineer, preferred age 25 - 40, of sound practical experience and with original and inventive mind, receiving recognition in his present post on that account.

These opportunities are permanent and progressive and hold promise of absorbing work on most attractive terms. Applications stating age, qualifications and experience should be personally addressed in confidence to G. B. Salmon,

MOLINS MACHINE CO. LTD., Evelyn St., London, S.E.8.

E7137A

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(MOTOR ACCESSORIES DIVISION)

SENIOR DESIGNERS

required to undertake design work on mass-produced instruments and light mechanisms from specification stages.

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Excellent working conditions and a four-figure salary make employment with this Company an attractive proposition.

Write in confidence to the Staff Manager,
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E7124 A

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The candidates, who should be preferably between the ages of 30 and 40, should also have a good craft apprenticeship in engineering, followed by some operator or supervisory shop floor service.

Although the practical ability to do the job will be the most essential factor in selecting the right man, some technical qualifications are desirable.

If you think that this vacancy appeals to you, please reply, giving full particulars, including experience, to BOX E4015, LPE, Romano House, 399-401, Strand, London, W.C.2. E7169 A

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GROUP WORK STUDY ENGINEER

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The group has installed work study in one of its factories and in order to extend the system, partially applied to the remainder, now require a Senior Group Engineer.

The appointment, which is a new one, will carry responsibility to the Managing Director for developing policy on the application so that it is of maximum practical value to management.

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Preferred age 35–45. Remuneration approximately £2,500, according to experience.

No information will be disclosed to our clients until candidates know their identity and have given permission after personal discussion. Please send brief details in confidence, quoting reference G.970, to M. B. Berks.

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LIMITED
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E7125 A

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MECHANICAL ENGINEER, aged 27, 13 years in engineering trade, maintenance and installations of cranes, automatic machines, engines, &c. Completed second year O.N.C., requires Staff Position in Drawing-Office or Assistant Engineer. Midlands or London area.—BOX No. E1882, "The Engineer." B

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—4500 SQ. FT., BARKING, ESSEX
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E7158 L

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AUSTRALIAN MANUFACTURER of building, shopfitting, &c., components, wishes to Manufacture on behalf of a British Company a speciality utilising Sheet Metal Forming Equipment.—Please write, in first instance, to O. W. Roskill, Industrial Consultants, 14, Great College Street, London, S.W.1. E1864 O

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1A, AUBERT PARK, LONDON, N.5.
CANonbury 1075 E871 MW

BOTTLING MACHINERY MANUFACTURERS invite offers for Hire of Skilled and Semi-Skilled Fitters for installation of machinery in London and Home Counties. Full details.—BOX No. E1879, "The Engineer." MW

CASTINGS.—We can save your porous castings, ferrous or non-ferrous, by an approved impregnation process ; sample castings treated ; A.I.D. approved.—Recupero, Ltd., 66, South Harrow Viaduct, Harrow, Middlesex ('Phone, Byron 1178). E575 MW

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AGENTS WANTED in Midlands and Northern counties, for shell moulded precision castings in aluminium, non-ferrous alloys and nickel iron. Give details area covered and organisation.—BOX No. E1881, "The Engineer." D

PATENTS

THE PROPRIETOR of British Patent No. 723,101, for "STEAM-AND-WATER COLLECTORS FOR STEAM-GENERATORS," desires to enter into negotiations with a firm or firms for the Sale of the Patent or for the grant of Licences thereunder.—Further particulars may be obtained from Marks and Clerk, 57 and 58, Lincoln's Inn Fields, London, W.C.2. E7159 H

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E1818 S

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WANTED, Machines of all Types.
CASH PAID.
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E123 F

WANTED, Tube Expanding Machine, Tube Cleaning Machine, 6in. to 8in. Screwing Machine, with collapsible head.—Fred Watkins (Boilers), Ltd., Coleford, Glos. E997 F

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Unused 4000-ton HYDRAULIC HEAVY PLATE FORMING and BENDING PRESS, table 18ft. by 10ft., weight 380 tons.
2000-ton DOWN-STROKE HYDRAULIC FORGING PRESS, ram 31in. dia., admits 8ft. 7in. wide, with horizontal sliding table, weight 200 tons.
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650-ton DOUBLE-ACTION DRAWING PRESS, by Lake Erie, bed 7ft. 6in. by 6ft. 8in., with self-contained pump unit.
MANY OTHER HYDRAULIC PRESSES OF ALL TYPES
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E7097 G

18FT. × 1¼IN. RHODES PRESS BRAKE for sale, 150 tons capacity (or 10ft. × 3/16in.) ; motorised 400/3/50 ; friction clutch, motor adjustment to ram, "Radiovisor" photo-electric safety equipment, 90 deg. forming tool, 10ft. 2in. long, and bottom die with 1⅛in. and 1¼in. openings ; bed and top beam solid steel, 18ft. 1in. long, between uprights 10ft. 2in., stroke 5in., die space 12in. Weight about 20 tons.—F. J. Edwards, Limited, 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham, 3. E7185 G

Classified Advts. continued on page 134

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STEAM BOILERS.—Cochran Vertical (New), 4ft. 6in., 8ft., 7ft. 6in., 7ft. and 6ft. in dia., 100/150 lb. w.p.; reconditioned 8ft. 6in. down to 3ft. dia.; Economic, 4ft. to 11ft. 6in. dia., including new 7ft. and 8ft. dia., 150, 180 and 200 lb. w.p.: 300 reconditioned Vertical Crosstube, all sizes.
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200 AIR RECEIVERS, stocked up to 9ft. dia., 100 to 500 lb. pressure.
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RAILWAY MATERIAL.—150 h.p. Stephenson Diesel Loco., fluid flywheel drive; Ruston 80/88 h.p. Diesel Loco., electric start, flameproof; Peckett 14in. by 22in. and 7in. by 12in. Steam Locos.; 3 miles 20 lb. Track, 24in. gauge bogies, turnouts, locos., &c.
STEEL PIPING.—50,000ft., 2in. Galvanised, new; 60,000ft., 3in. black new; 5000ft., 8in. seamless; 1000ft., 12in. seamless; 500ft., 14in. seamless; 400ft., 18in. riveted; 280ft., 21in. o.d. welded flanged; 3800ft., 21in. seamless flanged; 500ft., 24in. riveted; 1450ft., 27in. o.d. welded flanged; 216ft., 48in. riveted; 216ft., 60in. riveted.
CAST IRON PIPES.—Large stocks all sizes up to 24in. flanged and s.s. Immediate delivery.
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600

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3000kW., 6600/3/50, MET.-VICK., Pass-out/Condensing Steam Turbo-Alternator Set, date 1948, designed for 340 p.s.i.g. initially, 600 deg. Fah. temperature; also suitable for the following duties:

Output/kW.	Pass-out/lb./hour	Lb. Pressure
3000	60,000	40
1800	40,000	110
1800	40,000 double Pass/out at 1000kW., fully condensing.	

2500kW., 440/3/50, B.T.H., speed 3000 r.p.m., 250 p.s.i.g., 630 deg. F., steam consumption approx. 12·8 lb./kW./hr., with surface condenser, circulating pumps, &c. Also suitable for pass-out pressures varying between 18/35 p.s.i.

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6-ton Rapier Standard pet./elec. Mobile Crane, on solid rubber tyres.
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5-ton Smith Steam Loco. Crane, 4ft. 8½in. gauge, 35ft. jib. New 1949.
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OFFER FOR IMMEDIATE SALE

One Neals NM 2-ton Diesel Mobile Crane, 2400 series, Ruston engine, on pneumatics, 35ft. lattice jib. In good condition.
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RUSHTON & BRADBURN Double End Eccentric Clipping Press. Pressure exerted about 30 tons. Stroke 1½in. Size of bed 14in. diameter with provision for poppets. Weight approximately 75 cwt.
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3.	14×22	040 Barclay	—	160	22
4.	14×22	040 Barclay	—	160	22
5.	14×22	040 Barclay	1935	160	22
6.	17×24	040 Bagnall	1934	160	36
7.	17×24	040 Bagnall	1940	160	36
8.	17×24	040 Bagnall	1941	160	36
9.	17×24	040 Bagnall	1941	160	36
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ALL THE ABOVE MACHINES AVAILABLE FOR IMMEDIATE DELIVERY FROM STOCK, SUBJECT TO REMAINING UNSOLD.

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SEVEN 400 g.p.m., 300ft. hd., Diesel-engine-driven Sets, by CROSSLEY/SULZER.
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E210 G

SEDGWICK 10ft. by ¼in. Plate Bending Machine, in good second-hand condition.
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DOUBLE ACTING TWO-THROW VERTICAL PLUNGER PUMP, buckets about 6in. diameter by 6in. stroke, 10,500 g.p.h. against 50ft.; 4 h.p. Brook motor 3/50/400 volts.
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ABELSON offer the following equipment for immediate delivery:—
Smith 5-ton capacity Rail-mounted Steam Loco. Crane. New 1951.
Fully reconditioned Fowler 150 H.P. 0-4-0 Diesel Locomotive.
First-class Barclay 0-4-0 84 H.P. Diesel Locomotive.
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All the above machines suitable for 4ft. 8½in. gauge.
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E7005 G

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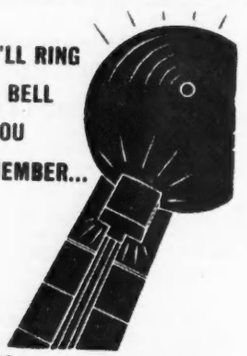

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AUCTION PROGRAMME

		Main Location	*Auctioneers*
May 22	**Miscellaneous stores,** including engines, ball bearings, tyres, inner tubes, etc.	M.O.S. Storage Depot, **Rotherwas, Hereford**	**RUSSELL, BALDWIN & BRIGHT, LTD.** (Dept. L), 20, King Street, Hereford. (Tel.: 4366.)
May 29–30	**Cooking ranges, pontoons, outboard motors, lathes, hardware, builders', plumbers' and electric equipment,** etc.	No. 1 Engineer Stores Depot, Lon: **Marston,** Nr. **Stratford on Avon, Warwickshire.**	**LOCKE & ENGLAND** (Dept L), 166 Parade, Leamington Spa. (Tel.: 2833.)
June 3–4	**Machine tools, cranes and miscellaneous stores,** including :—	M.O.S. Sub Depot, **Lily Lane, Byley, Middlewich, Cheshire.** (Sale at New Islington Public Hall, Ancoats, Manchester.)	**J. H. NORRIS & SON** (Dept. L), 9, Albert Square, Manchester, 2. (Tel.: Blackfriars 8373.)
	Holbrooke, Bradford, Denham, Smart & Brown and other centre and capstan lathes, universal grinder, vertical and thread millers, radial and pillar drills, horizontal and vertical presses, trailer-mounted and other diesel and petrol-engined generators and alternators, compressors, radio and electric equipment, spray and tyre inflation plant, M/T spares, lifting equipment, concrete mixers, Coles, Neal Rapid and other mobile cranes, GMC bulldozer power units, steel bar and tube, scrap accumulators, hand tools, canteen equipment, furniture, jackets, trousers, shirts, canvas shoes, scrap canvas, leather, webbing, blankets, rope and cordage, mattresses, telescopes, bearings, paint, etc.		
June 6	**Miscellaneous stores,** including :—	Returned Stores Depot, **Reed Hall, Colchester, Essex.**	**FENN, WRIGHT & CO.** (Dept. L), 146, High Street, Colchester, Essex. (Tel.: 3171.)
	tents, haversacks, paint, 10 cwt. stackers, gravity rollers, scrap metals, wireless test instruments, tools, hutting and building stores and furniture.		
June 9–12	**Vehicles, machine tools, miscellaneous stores,** including clothing, etc.	M.O.S. Storage Depot, **Royal Arsenal, Woolwich, London, S.E.18.**	**FULLER, HORSEY, SONS & CASSELL** (Dept. L), 10, Lloyd's Avenue, London, E.C.3. (Tel.: Royal 4861.)
June 17–18	**Machine tools and miscellaneous stores.**	M.O.S. Storage Depot, **Ruddington, Notts.**	**WALKER, WALTON & HANSON** (Dept. L), Byard Lane, Bridlesmith Gate, Nottingham. (Tel.: 47271.)
June 20	**Miscellaneous stores.**	Command Ordnance Depot, **Coypool, Marsh Mills, Plymouth.**	**WOOLLAND, SON & MANICO** (Dept. L), Kintlebury House, St. Andrews Cross, Plymouth. (Tel.: 65356.)

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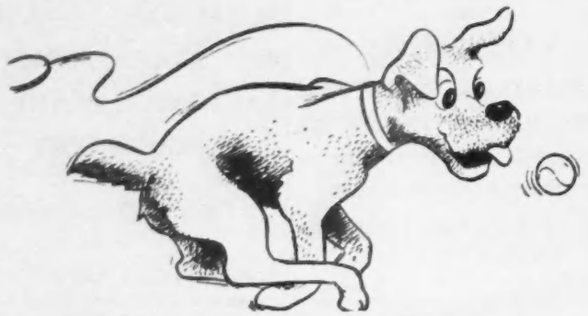

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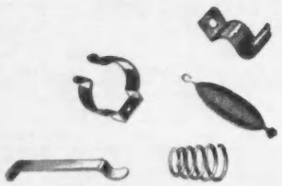

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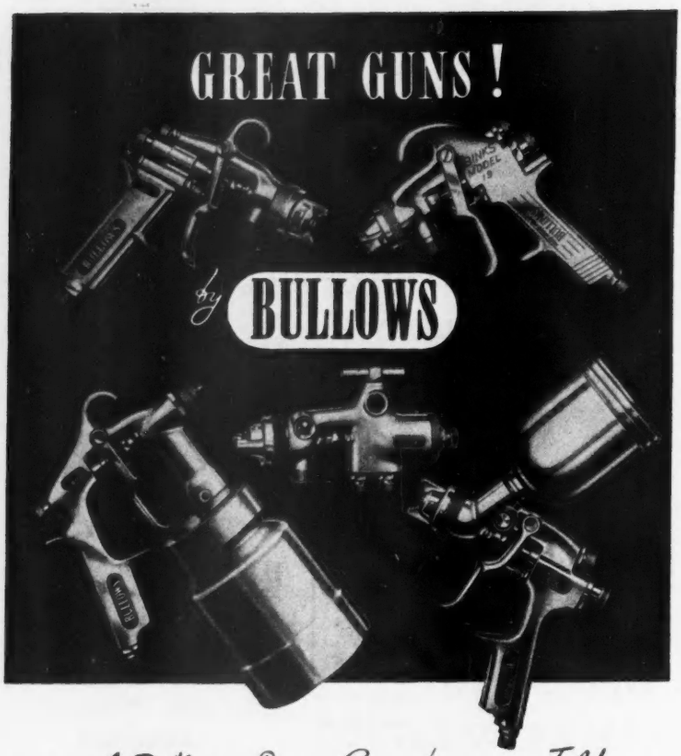

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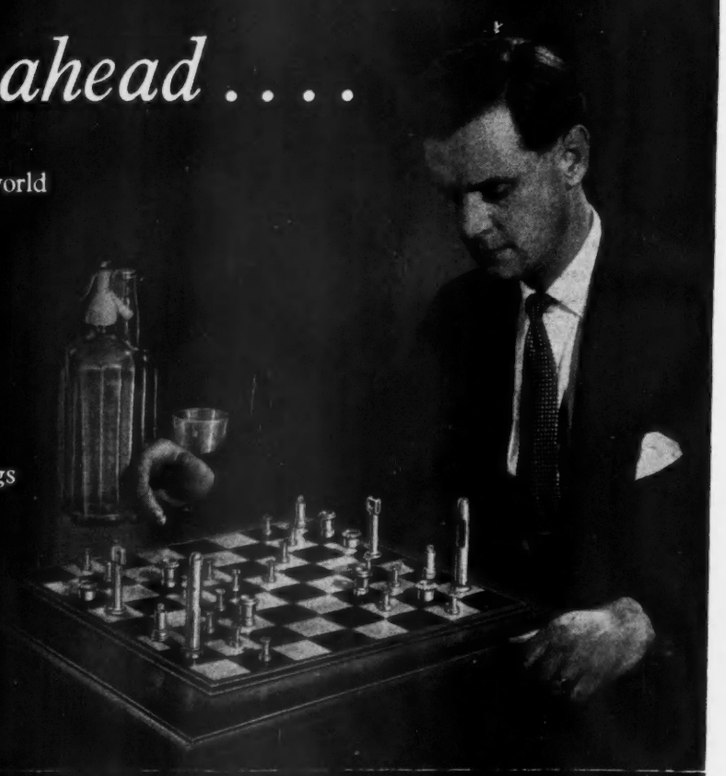

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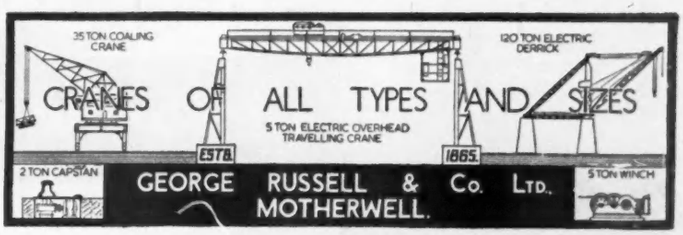

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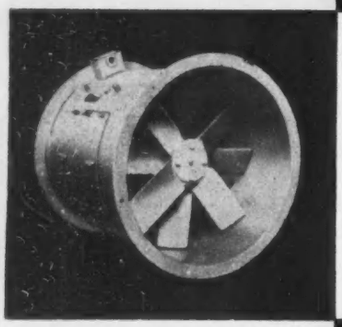
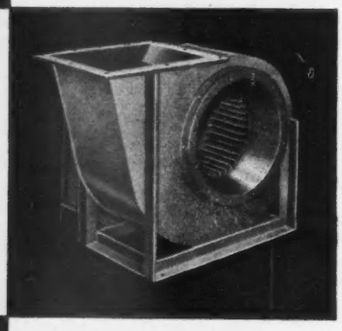
Airscrew *standard* fan ranges



Airscrew Axial Flow fans cover practically every application of this type of fan. The STANDARD RANGE is from 12″ to 27″. There are few problems in axial-flow design that cannot be solved by AIRSCREW.

—Specifications that mean what they say

These two AIRSCREW standard Fan Ranges—Axial Flow and Centrifugal—can usually be relied upon to provide the fan you need at the time you need it. Every phase of design and manufacture is so closely controlled that we *guarantee* no AIRSCREW Fan will give less than its rated duty—though it may give more. The Airscrew Technical Service is ready and willing to assist in the selection of the correct fan whether from standard range or individually designed.



Airscrew Centrifugal Fans —Forward Curve, Paddle Blade and Backward Curve —between them cover nearly all cases where a centrifugal fan is indicated.

AIRSCREW JICWOOD

Airscrew fans for industry

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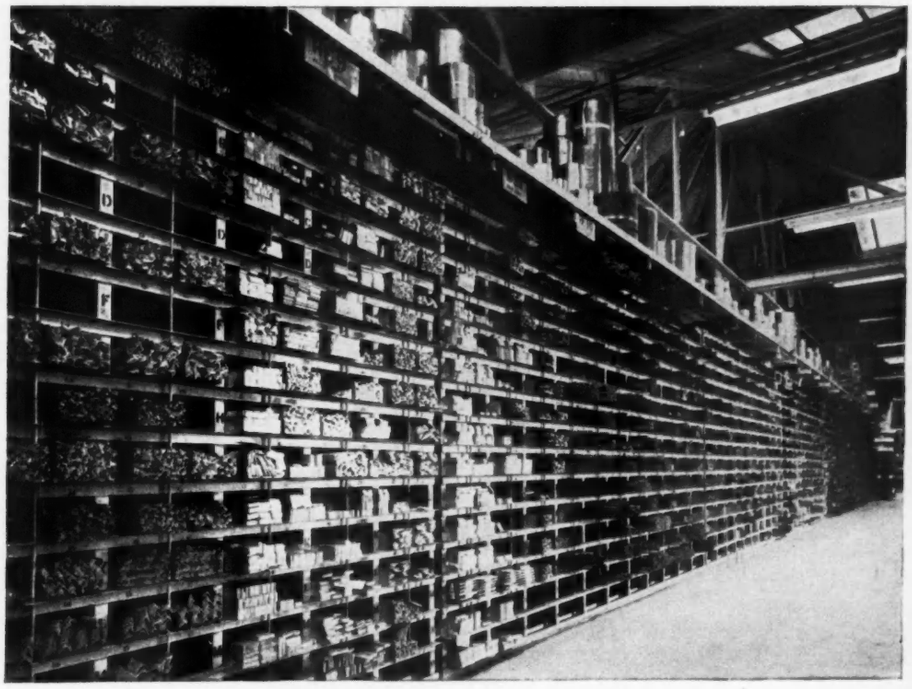
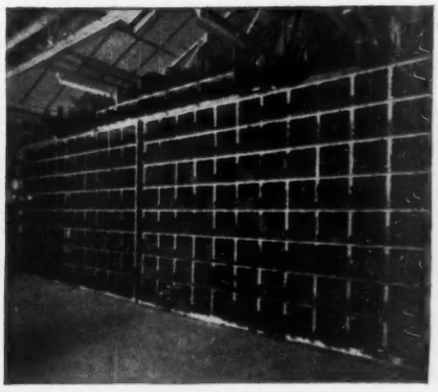
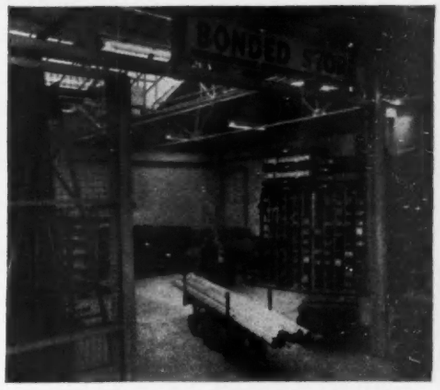




ABOVE *Brass and Copper Tubes are housed in sectionalised racks like this.*
LEFT *This Strip and Section Rack contains over 2,000 compartments.*



ABOVE *Our Bonded Store houses over 250 sizes of Tested Materials.*
BELOW *A fork lift truck operator moving Brass sheet pallets.*

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The Engineer

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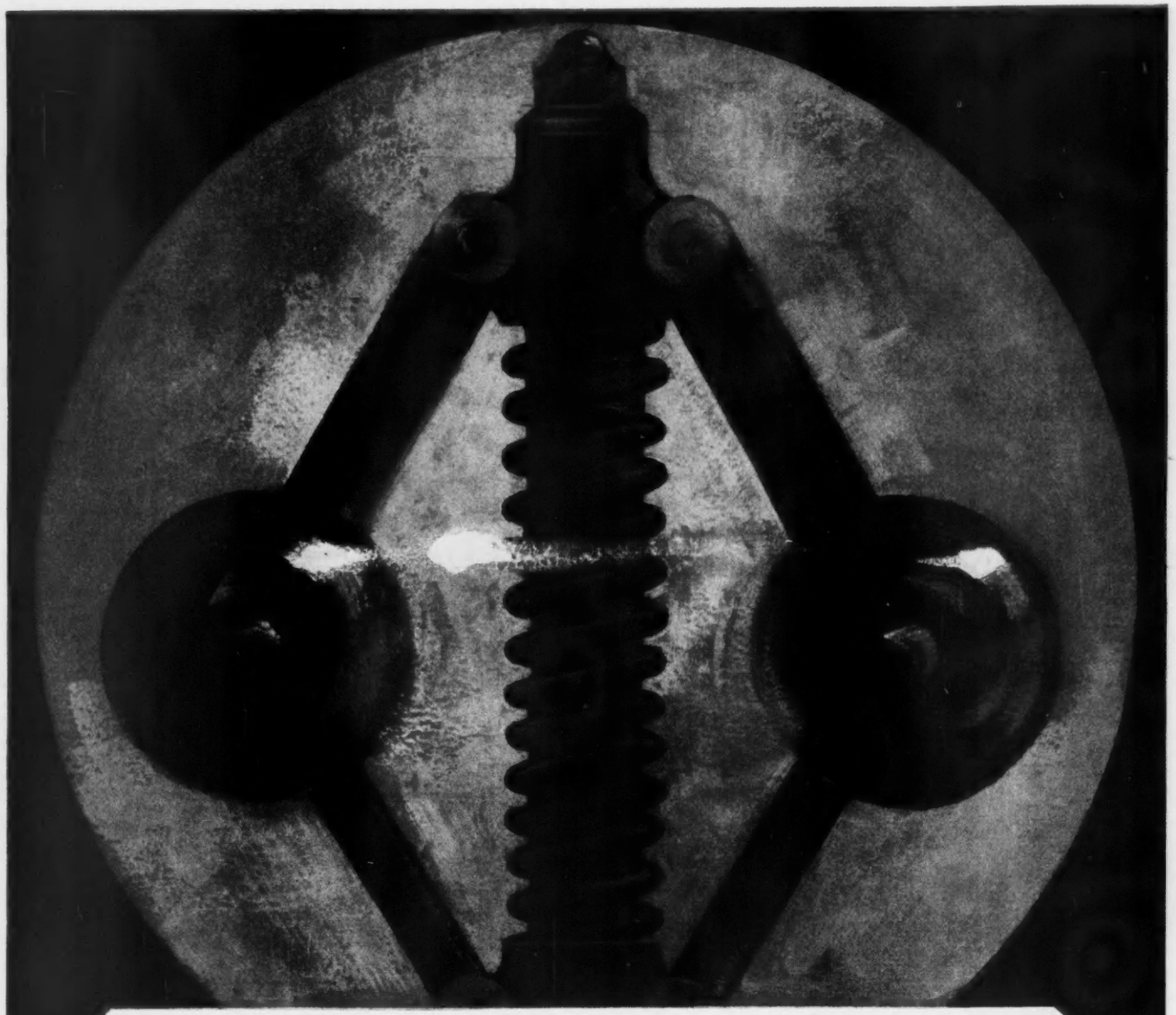

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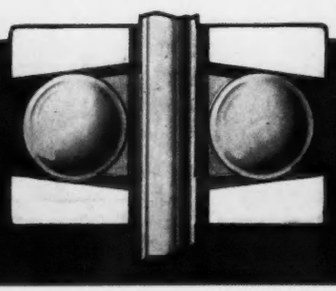
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